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Ground Cloud Dispersion Measurements During the Titan IV Mission #K14 (22 December 1994) at Cape Canaveral Air Station

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Systems Engineering
Space Launch Operations

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13. ABSTRACT (*Maximum 200 words*)

Results of launch cloud imagery and ground-level HCl measurements performed at Cape Canaveral Air Station (CCAS) during the launch of a Titan IV vehicle from Complex 40 on 22 December 1994 (mission #K14) are presented. Meteorological data measured at numerous CCAS locations prior to launch and during dispersion of the launch cloud are also presented. Such data will be used to determine how accurately atmospheric dispersion models such as the Rocket Exhaust Effluent Diffusion Model (REEDM) can predict toxic hazard corridors during launches of Titan and other vehicles at the ranges.

A wind from the northwest rapidly blew the launch cloud out to sea. This wind prevented the deployment of sensors for far-field (8–40 mi.), downwind HCl monitoring. HCl detectors and dosimeters were thus deployed at selected near-field locations. The responses obtained with these sensors are consistent with the launch cloud's trajectory. REEDM predicted a maximum ground-level HCl concentration 10.5 mi. downwind from Complex 40. No HCl sensors were present at far-field, offshore locations to determine the accuracy of this prediction. Future HCl monitoring efforts will emphasize far-field measurements.

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Preface

The Titan Systems Program Office (SMC/ME) of the Air Force's Space and Missile Systems Center is sponsoring the Atmospheric Dispersion Model Validation Program (MVP). This program will determine the accuracy of atmospheric dispersion models such as REEDM in predicting toxic hazard launch corridors at the ranges. This report presents launch cloud dispersion and meteorological measurements performed at CCAS during the #K14 mission's Titan IV launch as part of the MVP effort.

The MVP effort is being directed by an MVP Integrated Product Team (IPT) led by Lt. J. Schorie (SMC/MEEM). H. Lundblad of The Aerospace Corporation's Environmental Systems Directorate (ESD) is the IPT technical manager. G. Loper of The Aerospace Corporation's Laser and Optical Physics Department and H. Lundblad coordinated the preparation of this report from material contributed by a number of personnel participating in the ground cloud dispersion measurements during the #K14 mission.

Infrared and visible imagery measurements were made on the launch cloud by R. Abernathy, R. Heidner III, B. Kasper, and J. Knudtson of The Aerospace Corporation's Environmental Monitoring and Technology Department (EMTD) and D. Schulthess of Aerospace's Eastern Range Systems Engineering Directorate (ERD) in an attempt to monitor the cloud's growth, stabilization, and trajectory. D. Schulthess coordinated site selection and logistical support with appropriate Range organizations. A summary of these measurement results is provided by EMTD personnel in this report.

The ground-level HCl measurements were made by personnel from the 45th Medical Group Bioenvironmental Engineering Services (45 MDG/SGPB) organization and the NASA Toxic Vapor Detection Laboratory (NASA/TVDL). D. Schulthess of Aerospace's ERD and NASA/TVDL personnel designed the HCl sensor deployment plan. The HCl measurement effort was managed by Capt R. S. Allen of 45 MDG/SGPB. A number of other Air Force personnel assisted in the effort. These included TSgt. P. Yocum, TSgt. J. Miller, MSgt. S. Zeigler, Sgt. E. Everhart, SSgt. S. Mersnick, and TSgt. Mejias. Capt. P. Devane (45 MDG/SGPB) coordinated risk assessment predictions with 45 SW/SES from the Range Control Center Bioenvironmental Engineering Services console. D. Schulthess and Capt. Devane relayed launch cloud dispersion model predictions to Capt. Allen for optimum sensor deployment one hour prior to launch. NASA TVDL personnel who participated in the sampling effort included D. Lueck (TVDL manager), T. Hammond, B. Meneghelli, M. Springer, D. Curran, T. Hodge, D. Lemay, C. Fogarty, and R. Berile. A summary of the ground-level HCl measurement results is provided by Capt. Allen, D. Lueck, D. Curran, R. Berile, and B. Meneghelli in this report.

D. Schulthess of Aerospace's ERD, R. Evans of Ensco, Inc.'s Applied Meteorology Unit, and H. Herring of Computer Sciences Raytheon provided meteorological data determined before and after the launch. These data included measurements of ambient temperature, humidity, and wind speed and direction as a function of time at numerous meteorological towers at various tower elevations as well as rawinsonde data collected at various times. D. Schulthess provided REEDM predictions of ground-level HCl concentrations for use in this report.

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Executive Summary

Infrared (IR) and visible imagery measurements were made of the Titan IV launch cloud during mission #K14 by personnel from The Aerospace Corporation in order to monitor launch cloud development and dispersion. Personnel from the 45th Medical Group Bioenvironmental Engineering (45 MDG/SGPB) and the NASA Toxic Vapor Detection Laboratory (NASA/TVDL) performed ground-level measurements to determine the concentrations and doses of HCl deposited at selected locations beneath the path of the cloud. These data, and similar data from future launches, will be used with results from tracer gas releases to validate the use of REEDM in predicting toxic hazard corridors at CCAS and Vandenberg Air Force Base (VAFB). The THCs assess the risk of exposing communities nearby the ranges to HCl exhaust from vehicles employing solid propellants or to the accidental release of hydrazine fuel or nitrogen-tetroxide propellant vapors into the atmosphere.

Diagnostics for the Titan IV's ground plume consisted of two-camera IR and two-camera visible imagery augmented by Fourier Transform Infrared (FTIR) spectroscopy in the 3–5 μm and 8–12 μm spectral regions. Poor weather (water mist and a 500-ft cloud deck) limited plume observation and defeated the majority of the cloud image data collection efforts. Image processing of data from the two IR cameras was not attempted. Some information was derived from the 3–5 μm FTIR spectroscopy.

The launch plume quickly rose and was blown out to sea by a wind from the northwest. This wind condition eliminated the opportunity to deploy detectors and dosimeters for far-field, downwind HCl monitoring. HCl detectors and dosimeters were thus deployed at locations in the immediate vicinity of Complex 40 and at limited near-field locations. Up to 0.4 ppm of HCl was detected by two of six detectors deployed. One detector that sensed HCl was located outside of the perimeter fence 150 yards east and slightly south of the launch pad. The other detector was located 6.4 mi. south of Complex 40. Of the dosimeters deployed in the near field, only those located on four lightning towers, each 50 yards away from the launch vehicle, showed a response to HCl. High exposure doses of HCl (127–183 ppm-min) were sensed by these dosimeters. Dosimeters placed at the perimeter fence 150 yards from the launch pad registered no response. The lack of dosimeter response at the perimeter fence is consistent with the observation that the initial ground plume is extremely buoyant and that it achieves a high vertical velocity upon being deflected upward by the berm adjacent to the launch pad. The response levels obtained on the detectors and dosimeters placed in the near field are consistent with expectations based on the launch cloud's predicted trajectory. REEDM predicted a maximum ground-level HCl concentration of 2.8 ppm at a distance of 10.5 mi. downwind from Complex 40. No HCl detectors were present at this and other offshore locations to determine the accuracy of this prediction.

Future ground-level HCl monitoring efforts will emphasize performing measurements in the far field at distances of 8–40 mi. These measurements will establish the degree of potential toxic exposure risk to personnel in communities adjacent to the launch ranges. Far-field monitoring possibilities will depend upon whether the prevailing launch day winds carry the plume towards an area that is accessible for detector and dosimeter placement.

1. Introduction

Various atmospheric dispersion and chemical kinetic models have been, or are being, developed to predict the transport and fate of hazardous species that may be released into the atmosphere during Eastern Range and Western Range Air Force launch vehicle operations at Cape Canaveral Air Station (CCAS) and Vandenberg Air Force Base (VAFB), respectively. There is a strong need to collect data that can be used to validate the performance of these models. Launch vehicles that employ solid propellant rocket motors release large hydrogen chloride (HCl) clouds into the launch area. The possibility also exists that large amounts of the hazardous hydrazine rocket fuels or the oxidizer nitrogen tetroxide can be accidentally released into the launch area during propellant transfer operations or as a result of a launch vehicle explosion.

The Air Force launch range safety organizations of the 45th Space Wing at Patrick Air Force Base (45 SPW/SE) and 30th Space Wing at VAFB (30 SPW/SE) are respectively responsible for assuring that Eastern and Western Range launches are carried out only when meteorological conditions are such that the extent of the HCl, hydrazine-fuel, and N_2O_4/NO_2 toxic hazard corridors (THC) are sufficiently limited that exposure of personnel to these species cannot occur in communities nearby CCAS and VAFB. Predictions of toxic concentrations of these vapors in public areas can lead to costly launch delays. The present use of non-validated models requires the use of conservative launch criteria. The development and validation of accurate atmospheric dispersion models will increase launch opportunities and significantly reduce launch costs. The Titan System Program Office (SMC/ME) of the Air Force's Space and Missile Systems Center has thus established the Atmospheric Dispersion Model Validation Program (MVP). The goal of this program is to collect data to determine the accuracy of current and future atmospheric dispersion and chemical kinetic models in predicting THCs during launches of Titan and other vehicles at CCAS and VAFB.

The MVP effort will involve the collection of data during Titan launches at CCAS and VAFB to characterize HCl launch cloud rise, growth, and stabilization as well as launch cloud transport and diffusion. These data, as well as data from tracer gas releases, will in particular be used to determine the capability of the Rocket Exhaust Effluent Diffusion Model (REEDM) for predicting THCs at the launch ranges. REEDM (see Appendix A) is used at CCAS and VAFB to predict the locations of THCs in support of launch operations. It is applied to large heated sources of toxic air emissions such as nominal launches, catastrophic failure fireballs, and inadvertent ignitions of solid rocket motors. It uses launch vehicle and meteorological data to generate ground-level concentration isopleths of HCl, hydrazine fuels, NO_2, and other toxic launch emissions. Launch holds may occur when REEDM toxic concentration predictions exceed adopted exposure standards. REEDM is a unique and complex model based on relatively simple modeling physics. It has a long developmental history with the Air Force and NASA, but has never been fully validated. A recent change in toxic exposure standards adopted by the range safety offices has resulted in longer REEDM THCs and a higher potential for launch holds. As a result, validation of REEDM has been identified as a range safety priority.

The MVP has been organized and is being directed by the MVP Integrated Product Team (IPT). SMC/ME is serving as the IPT leader while the Aerospace Corporation's Environmental Systems Directorate is the IPT technical manager. The IPT consists of personnel with expertise in atmospheric dispersion modeling, meteorology, and atmospheric concentration field measurements. MVP participants include personnel from 30 and 45 SPW (and their contractors), SMC, The Aerospace Corporation, NASA, NOAA, and Lawrence Livermore. Key functions include program planning, field data collection, data review and compilation, range coordination, and model validation (see Appendix B).

This report presents the results of limited measurements performed at CCAS during the launch of a Titan IV vehicle on 22 December, 1994 (mission #K14). Visual and infrared imagery measurements were made to monitor the growth, stabilization, and trajectory of the launch cloud. Measurements were also made during this launch of the ground-level concentrations and doses of HCl deposited at selected locations beneath the path of the launch cloud. [Dosimeters developed by NASA's Toxic Vapor Detection Laboratory (NASA/TVDL) for the ground-level HCl monitoring are described in Appendix C]. The imagery and ground-level measurement results are presented in sections II and III, respectively. REEDM predictions of the locations of maximum ground-level HCl concentrations following launch cloud stabilization and HCl dispersion to the ground are also shown section III. The REEDM predictions are based upon meteorological data determined 0.2 hours before launch. Meteorological data were measured at a number of CCAS monitoring locations prior to launch and during development and dispersion of the launch cloud. These data are tabulated in Appendix D. Only a qualitative discussion of the accuracy of the REEDM predictions is possible here due to the limited cloud imagery and ground-level HCl data measured during the #K14 launch. The study shows the need for obtaining better three-dimensional cloud images and HCl measurement data of higher spatial-density during future launches.

2. Imaging and Spectroscopy of the Titan IV #K14 Launch Ground Cloud

[The material in this section was contributed by R. N. Abernathy, R. F. Heidner III, B. P. Kasper, and J. T. Knudtson of The Aerospace Corporation's Environmental Monitoring and Technology Department within the Space and Environment Technology Center]

2.1 Background

While analyzing the multispectral IR imaging from a previous Titan IV night launch (mission #K-9) at CCAS, it was determined that the detected distribution of spectral radiance through the multiple interference filters on the Inframetrics 522 "filter switcher" camera did not agree with predictions based on FTIR spectra of solid propellant pit burn clouds. Post-launch atmospheric transmission calculations using the measured temperature and humidity values during the #K-9 launch showed strong atmospheric absorption of the long wavelength radiation (near 11μm) where the Al_2O_3 emission band is located.

For #K-14, a different approach was used. The IR cameras were operated broadband in the 8-12μm region and simultaneous FTIR spectra were taken of the ground cloud. The intent was to image the plume evolution with high sensitivity (but no molecular discrimination) and to begin to build a database (with the FTIR) of characteristic narrowband emission features detected under representative launch conditions.

Although the launch took place just after dusk on December 22, 1994, visible cameras are always deployed for scene archival and for direct videotape recording of camera platform azimuth and elevation angles as well as IRIG B time (an Inter-Range Instrumentation Group 100 Hz data rate time format).

2.2 Camera Field Deployment

Selecting camera viewing sites for imaging launch ground clouds at Cape Canaveral is both an art and a science. Figure 1 depicts the area surrounding Space Launch Complexes 40 and 41. Titan IV #K-14 was launched from the former of these two complexes. The Atlantic Ocean and the Banana River severely restrict the positioning of monitoring equipment. Furthermore, there is an exclusion zone that results from modeling the debris hazard from a low-altitude abort. A second restricted zone results from the REEDM calculation of the toxic hazard footprint from propellants and propellant products, particularly from nitrogen tetroxide following a low-altitude abort.

Several more factors influence the collection of good IR imagery data. So long as the plume can be kept within the field of view (FOV) of the camera, it is advantageous to be as close as possible to the plume. As mentioned above, atmospheric water (both line spectra and continuum absorption) can attenuate radiance from the ground cloud over long pathlengths in humid air. Long

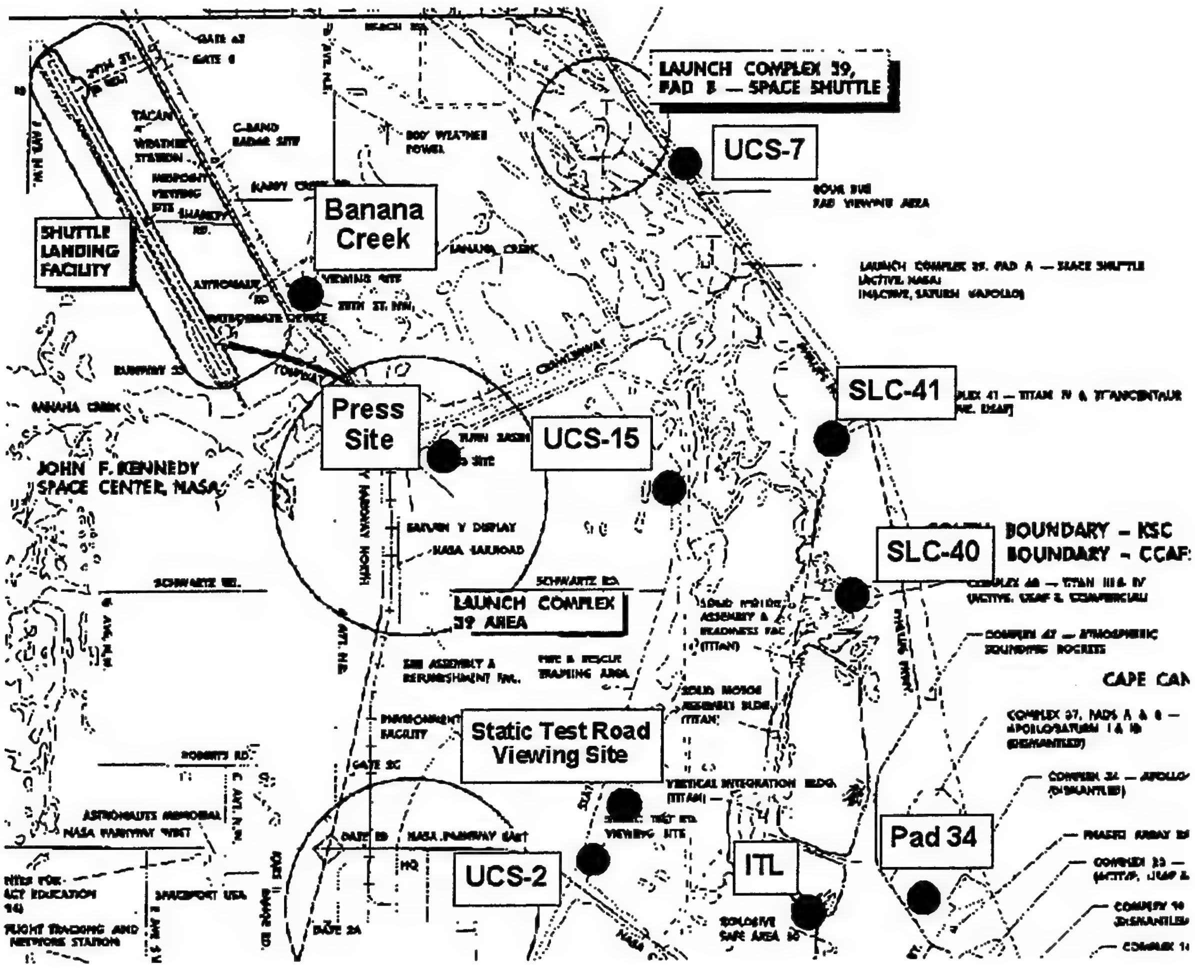


Figure 1. Aerospace camera sites relative to SLC-40 and -41, CCAS.

camera-to-plume distances also equate to low camera elevation angles for a given plume height. This increases the slant path through the part of the atmosphere containing high water density as well as increasing the probability that dense ambient temperature water clouds will be part of the background scene for the IR cameras. Finally, good triangulation of the plume requires that the angle between the camera viewing axes be as close to 90° as possible. Naturally, all of these criteria cannot be satisfied perfectly at the same time. The goal is to select prioritized pairs of sites that can be downselected as close to launch time as possible on the basis of meteorological data extrapolations.

This selection strategy worked well for the initial deployment on 12/20 (scrubbed launch) and on 12/22 (successful launch). On December 20th, winds from the east were predicted for t=0. The sites selected were the Static Test Road Viewing Area (STRVA) and the Titan Road Guard Station (TRGS). These sites are 2.7 and 3.5 mi. from SLC 40, respectively. On December 22nd, winds from the north were predicted for t=0. For the deployment at this successful launch, the STRVA site was again selected (Inframetrics 522 camera and FTIR) and UCS 7 was selected as the second

site (Inframetrics 600). These sites are 2.7 and 4.0 mi. from SLC 40, respectively. Two excellent sites identified for viewing Titan IV launches are the Pad 34 Blockhouse (roof) and UCS 15, although their close proximity to the launch complexes makes access difficult.

2.3 Instrument Performance

All instruments used in this test were shipped via Orlando in a single Delta Air Cargo container. Both infrared cameras and the Mattson FTIR were tested on 12/17 in the parking lot of the E&L Building at CCAS. All calibrations appeared consistent with those done previously in the laboratory in El Segundo.

Three high quality Motorola cellular phones were obtained on loan from the Aerospace office at Cape Canaveral. These phones were vital to the logistics of the operation. Two gasoline-powered generators were leased in the event of a power outage or in case a camera site was selected that had no permanent electrical power. Neither of these events occurred.

Weather conditions at t=0 were poor from the perspective of IR viewing. A thick cloud deck was present at roughly 500 ft. The launch time (17:19 EST) was relatively close to sunset. During data collection and subsequent radiometric calibrations, a fine mist began to form. During the post-launch calibrations, it was obvious that the mist was condensing on the window of the FTIR detector dewar, lowering the sensitivity and causing errors in the calibration of detected radiance.

2.4 Results

2.4.1 Infrared Imaging

In order to extract the parameters from the ground cloud that are required for comparison to REEDM, the entire cloud must be detectable in the field of view of the camera. Figures 2a, b, c, and d illustrate that the majority of the #K-14 exhaust ground cloud “disappears” with respect to the 500’ cloud deck within 1 minute.

It is well to remember that these images are radiance differences of plume plus background minus the radiant background. If the background is a blackbody emitter with the same temperature as the plume, no contrast in radiance will be observed. This point will be addressed again during the discussion of the 8-12μm FTIR spectra.

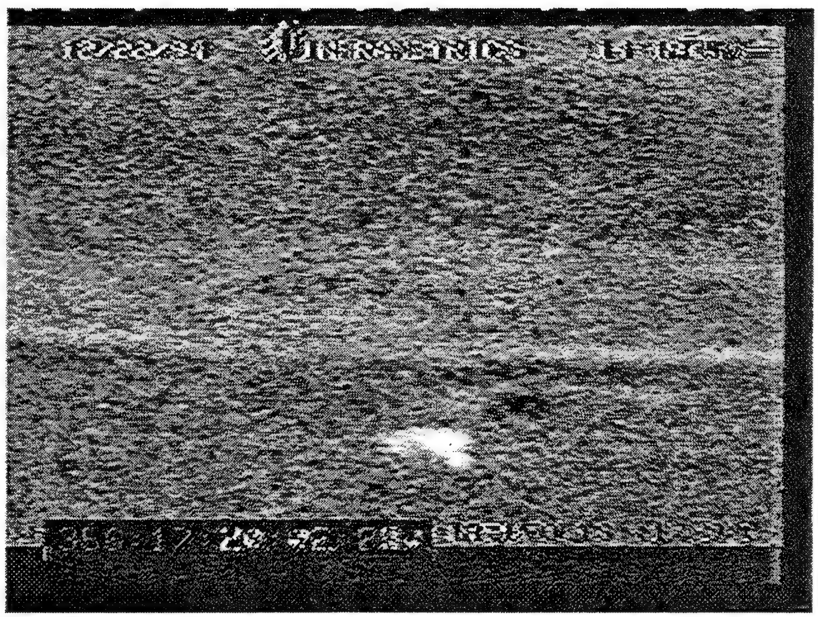
Based on previous Titan IV launches, one expects the ground cloud to stabilize between 5-10 minutes after the launch. Since the top of the plume is clearly clipped by 1 minute after launch, we have concluded that the IR imagery datasets do not warrant further analysis. The data are archived on video tape and selected portions have been transferred to optical disk.

T + 0:15

T + 0:30

Figure 2. Background-subtracted IR imagery of K-14 ground plume from UCS-7.

T + 0:45



T + 0:60

Figure 2 (cont'd). Background-subtracted IR imagery of K-14 ground plume from UCS-7.

2.4.2 Fourier Transform IR Spectroscopy: 3-5μm

Prior to the launch, a protocol was established for collecting FTIR data. The single Mattson FTIR spectrometer has two detectors: an InSb detector for the 3-5μm region and a HgCdTe detector for the 8-12μm region. They cannot be operated simultaneously. The plume radiance in the 3-5μm

region is a strong function of temperature. Because the plume is initially "hot," an initial set of 10 measurements (7 on-plume/3 off-plume) was made in the 3-5μm immediately after launch. Figure 3 represents a portion of that spectral region from 2800 cm-1 to 2950 cm-1 (3.39-3.57μm).

Qualitatively, one expects the radiance from a warm plume core to be partially absorbed by colder effluents near the plume boundary and by the atmosphere that intervenes between the plume and the camera. In Figure 3, one can observe that the plume radiance resembles the transmission of the atmosphere. In addition, however, one finds a correlation between the positions of major HCl absorption lines and dips in the detected plume radiance. Additional 3-5μm spectra were recorded at longer times, but showed no features of interest. This is to be expected from an ambient temperature plume viewed against a cloud background.

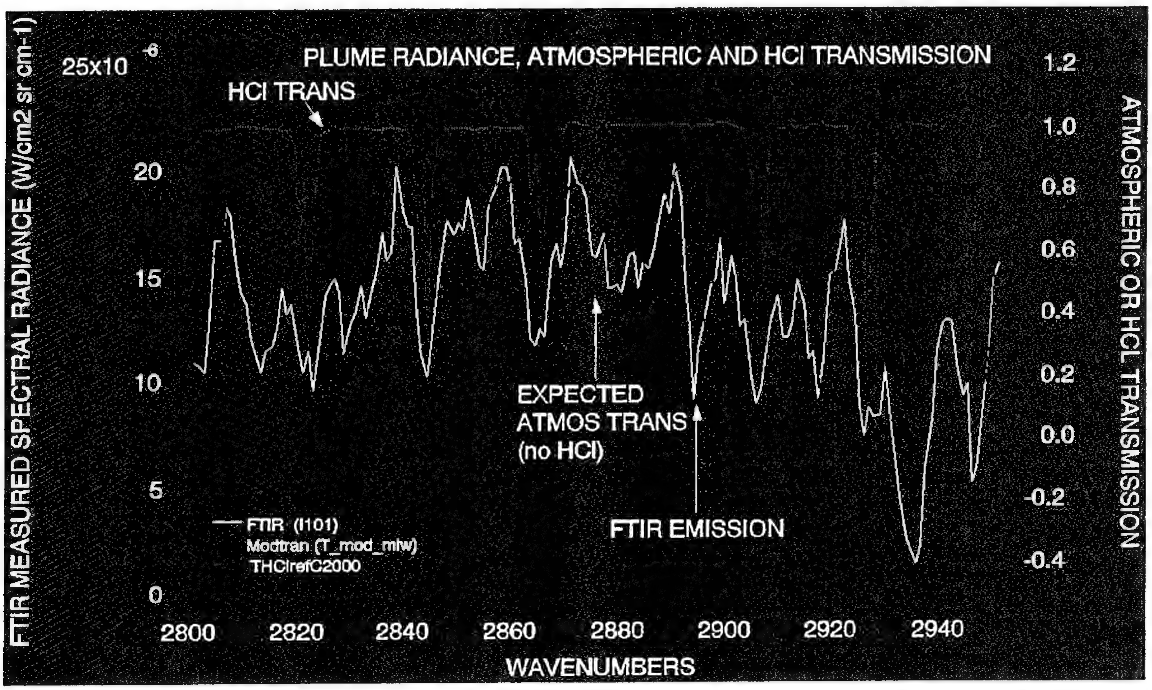


Figure 3. Plume radiance, atmospheric and HCl transmission.

2.4.3 Fourier Transform IR Spectroscopy: 8-12μm

The data collection protocol discussed above resulted in obtaining an additional 30-35 FTIR spectra in the 8-12μm region beginning at approximately t + 8 minutes and ending at approximately t + 45 minutes. Referring to Figure 2, it can be seen that it is impossible to isolate the launch ground cloud from the cloud deck. As expected, when the spectrometer was alternatively pointed at the estimated plume position and away from the plume position, each spectrum appeared to be identical. The difference spectrum was in good agreement with the noise equivalent spectral radiance (NESR) of the instrument, roughly 1.3 x 10-7 watts/steradian-cm2-(cm-1). Thus, no information was obtained about the plume that would be useful for selecting camera filters for a future launch.

2.5 Lessons Learned

One lesson that bears repeating is that there are weather conditions that permit launch but totally preclude IR imaging and spectroscopy. The second lesson learned was reinforced from the earlier K-7 launch. Because of the shifting wind directions at the Cape and the difficulty of shifting camera positions as the launch time approaches, deployment to three (3) camera positions greatly improves the probability that two of those positions will provide usable data for reconstructing the plume in three dimensions. In particular there is a very real chance that the plume will come directly over any single camera site, overfilling the camera's field of view and preventing the extraction of plume depth and width information. Finally, packing, unpacking and transporting the equipment consumed a major fraction of the time devoted to this field campaign. Acquisition of Titan-dedicated hardware is in progress that will greatly increase the fraction of time devoted to data acquisition, analysis, and documentation.

3. Ground-Level HCl Measurements

[The material in this section was abstracted from contributions by Capt. Robert S. Allen of the 45 MDG/SGPB organization at Patrick AFB as well as Dale Lueck, Dan Curran, Ronald Barile, and Barry Meneghelli of NASA KSC's Toxic Vapor Detection Laboratory.]

3.1 Background

The REEDM atmospheric dispersion model used at the 45th Space Wing (45 SPW), Patrick AFB, FL, and the 30th Space Wing (30 SPW), Vandenberg AFB, CA, lacks real-time monitoring data to verify the model's concentration predictions. Each Space Wing's launch environment has unique weather and terrain that produce specific effects that the model must be configured to in order to improve the accuracy and consistency of results. As outlined in Appendix B, plume imagery, HCl monitoring, and tracer gas release studies will be carried out in the Model Validation Program to determine plume HCl concentrations and transport behavior. This section describes the results of the ground-level HCl monitoring carried out during mission #K14 at the Eastern Range. 45th Medical Group Bioenvironmental Engineering (45 MDG/SGPB) and NASA Toxic Vapor Detection Laboratory (NASA/TVDL) personnel were responsible for this monitoring. The HCl dosimeter tubes and Geomet HCl concentration analyzers used in the measurements were deployed by 45 MDG/SGPB personnel. NASA/TVDL personnel supplied and analyzed the dosimeters.

3.2 Objectives

The objectives of the ground-level HCl monitoring effort during the Titan #K14 mission at CCAS Launch Complex 40 on 22 December, 1994 were to:

a. measure launch cloud HCl concentrations with Geomet real-time analyzers at model predicted areas;

b. compare ground-level concentration data to model predictions; and

c. use HCl dose measurements performed with dosimeter tubes to verify measured HCl concentrations.

3.3 HCl Monitoring Procedures

3.3.1 Measurement approach

It was the aim of 45 MDG/SGPB and NASA TVDL personnel to determine downwind plume HCl concentration and dose data at various near-field, fixed-site locations within the model's predicted downwind corridor using Geomet HCl analyzers and NASA TVDL-prepared dosimeter tubes.

3.3.2 Concentration Measurement Instrumentation

(1) Geomet HCl Monitors: The Geomet monitors employed (Model 401B or 401S) detect airborne HCl (gaseous- or aerosol-based HCl) through the use of a luminol-based chemilluminescent reaction. The luminol reagent is dissolved in a solution that is comprised of 0.5 M sodium carbonate, 0.3% hydrogen peroxide, 0.0858% phosphoric acid, and 10% sodium bromide. The Geomet monitor registers a response in the presence of chlorine. Under nominal conditions, the monitor has a minimum detectable sensitivity of 0.01 ppm of HCl, 5% accuracy, 5% reproducibility, 5% linearity, a noise level of less than 1%, and a 1 second response and recovery time.

(2) Strip chart recorders: Soltec portable 2 channel recorders were used. The recorders were set for the 0-10 volt output of the Geomet instruments.

3.3.3 Dosimeter Tubes

NASA/TVDL personnel developed length-of-stain type dosimeter tubes that are capable of monitoring HCl vapor exposure doses down to the 1 ppm-minute level (see Appendix C). An effort is being made to optimize the design of this dosimeter to extend its sensitivity to even lower levels. To date, this effort has not resulted in significant improvement in dosimeter sensitivity. Because of the rainy weather on the day of the actual launch (22 December 1994), dosimeters fitted with Teflon diffusion membranes were used for ground-level HCl monitoring. The dosimeters provide a reduced sensitivity (approximately 5 ppm-minutes) when the diffusion membrane is placed over the otherwise open-end of the dosimeter tube. The membrane prevents moisture from being blown into the dosimeter, dissolving the dye, and causing the loss of collected data.

3.4 Ground-Level HCl Concentration Monitoring Results Using Geomet Analyzers

3.4.1 Near-Field, Fixed Site #1

[Site #1 was located approximately 150 yards east of the Launch Complex 40 pad just outside of the perimeter fence and just south of the blast area.] One Geomet analyzer was used at this location. As designated in Figure 4, the Geomet analyzer at site #1 detected the presence of HCl at concentrations up to 0.4 ppm from T + 0 through T + 3 hours. There was a light north wind which most likely facilitated the detection of HCl at this site. Visual observation of the area indicated that the plume was extremely directional and greatly influenced by the berm located just inside the perimeter fence. The fence itself was blown down behind the berm. It was evident where the plume had impacted beyond the berm since a distinct path was outlined by heat effects. The impact area extended approximately 50 yards beyond the berm and ended before the brush on the other side of the perimeter road. Post calibration of the Geomet instrument verified its accuracy.

3.4.2 Near-Field, Fixed Site #2

[Site #2 was located approximately 150 yards east of the launch pad just outside the perimeter fence and just north of the blast area.] One Geomet analyzer was used at this location. This site was located just out of the affected area, however, the north wind put it upwind of the plume.

Because of the directional nature of the plume no HCl was detected. Post calibration of the Geomet analyzer verified instrument accuracy.

3.4.3 Near-Field, Fixed Site #3

[As indicated in Figure 4, site #3 was located approximately 0.5 mile southeast of the launch pad along Phillips Parkway.] Two Geomet analyzers were used at this site. Although visible observation of the plume showed that it did travel extremely close to, if not directly over site #3, no HCl was detected by either of the Geomet analyzers. Post calibration of the instruments verified their accuracy.

3.4.4 Near-Field, Fixed Site #4

[Site #4 was located approximately 3 miles south-southeast of Launch Complex 40 next to the beach at Complex 34.] The one Geomet analyzer used at this location detected no HCl. Post calibration of the instrument verified its accuracy.

3.4.5 Near-Field, Fixed Site #5

[Site #5 was located approximately 6.4 miles south of Launch Complex 40 next to the beach at Complex 11. Refer to Figure 4.] One Geomet analyzer was used at this location. The analyzer indicated the presence of up to 0.4 ppm HCl from a time of 17:53 EST (34 minutes after the launch) through 18:12. These results suggest that a section of the plume, a separate piece of the plume, or the main part of the plume transited site #5. The plume arrival time was consistent with the launch time (17:19) and the measured 13 mph winds at the suspected plume stabilization height of 500 to 1000 feet above ground level. The plume stabilization height was not observed because of a 450 foot ceiling. Post calibration of the Geomet analyzer verified its accuracy.

3.5 Ground-Level HCl Monitoring Results Using NASA/TVDL Dosimeters:

Mission # K14 was initially scheduled to be launched on 20 December, 1994. Nearly one hundred HCl dosimeters (without Teflon diffusion membranes) were deployed primarily in far-field positions, up to 11 miles downrange of Launch Complex 40. The southeast wind conditions allowed monitoring sites to be located directly in the predicted path of the exhaust plume. The area of coverage was determined by the T - 4 hour weather balloon data as interpreted by the computer model. However, the 20 December launch was scrubbed due to unfavorable weather conditions. A heavy cloud layer and scattered showers with strong winds were present in the launch area. Upon recovery, it was noted that moisture had seeped inside the cover of several of the dosimeters and the dye layer had been washed off.

On 22 December, 1994, the day of the actual launch, the weather conditions were again cloudy with scattered showers. The decision made at that time was to deploy dosimeters fitted with the Teflon diffusion membrane. The diffusion membrane reduces the dosimeters' sensitivity but prevents moisture from entering the dosimeters and causing the loss of data. The prevailing wind at T - 4 hours was from the northwest at 8-10 knots, and the plume was expected to rise and be

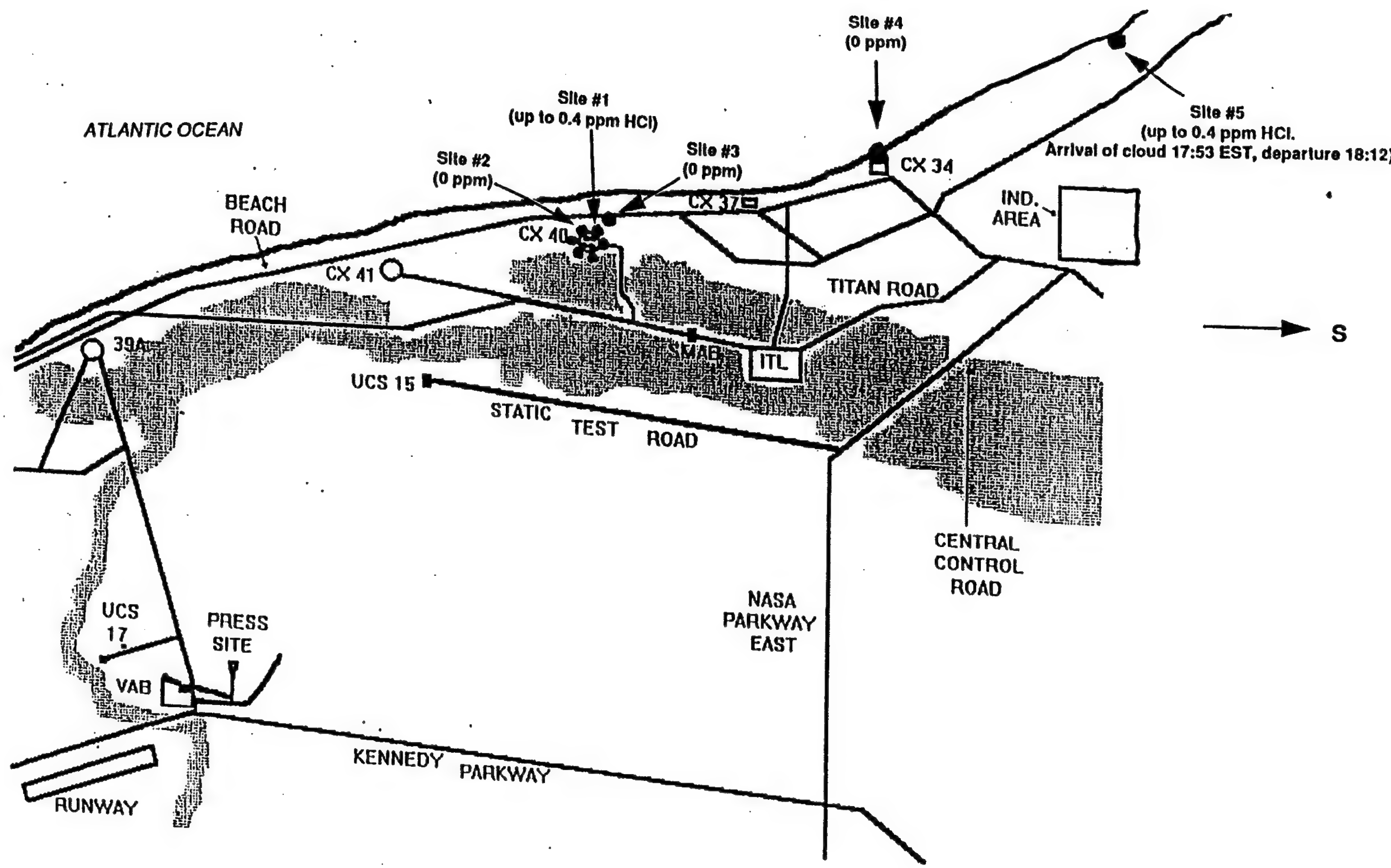


Figure 4. Ground-level HCl concentration monitoring locations using Geomet Analyzers.

blown out to sea. This wind direction did not allow any far-field, downwind monitoring and no dosimeters were deployed other than in the immediate vicinity of Complex 40 and on the Geomet analyzers at Near-Field, Fixed-Site #3. The potential for a high level of HCl in the launch area made the dosimeters equipped with Teflon membranes more suitable.

Six dosimeters were placed at a height of five feet on the perimeter fence surrounding Complex 40 as shown in Figure 5. The perimeter fence is approximately 200 yards from the launch vehicle. These dosimeters showed no indication of HCl exposure. A dosimeter was placed five feet above the ground on each of the four lightning towers. The towers are about 50 yards from the vehicle. All of these dosimeters indicated high levels of HCl exposure. The approximate doses recorded by these dosimeters are shown in Table 1. The dosimeters that were attached to the Geomet analyzers at Site #3 showed no response. As described above, neither of these Geomet instruments indicated any presence of HCl during the sampling period.

Table 1. Dosimeter results from 22 December 1994 Titan IV Launch

Location	Length of Stain (inches)	HCl Dose (ppm-min.)
NE Lightning Tower	0.765	126.9
SE Lightning Tower	0.885	168.9
SW Lightning Tower	0.920	183.1
NW Lightning Tower	0.920	183.1

3.6 Findings and Conclusions:

Figure 6 shows the trajectory of the plume predicted by REEDM based upon the use of meteorological data determined at T - 0.2 hours. The plume was predicted to move in a near easterly heading (112°-116°) and have a maximum ground-level HCl concentration of 2.8 ppm at downrange distance of about 17 kilometers (10.5 miles). The REEDM predictions differed from the results obtained by 45 MDG/SGPB during the HCl ground-level sampling. The predicted plume movement of a 112°-116° heading was inconsistent with initial observation of the plume prior to it entering the overcast ceiling. The plume was observed to follow a more southeasterly heading (130°-150°). Observation was very limited however because of the low cloud deck. The lower portion of the plume was visible for approximately 2-5 minutes.

The plume's path is very predictable at locations nearest the pad. 45 MDG/SGPB personnel have carefully observed the last three Titan IV launches. The initial ground plume is observed to be very directional. It hits the berm adjacent to the pad and is deflected upward greatly increasing its vertical velocity. Some down wash occurs over the berm for approximately 75 yards. The entire impact occurs in less than 20 seconds. The plume is extremely buoyant and has a high vertical velocity imparted to it by the berm deflection during this time. Minimal deluge water is used during Titan launches. The deluge water seems to have a negligible effect on development and transport of the plume.

Far-field HCl monitoring was not possible during the 22 December launch because the northwest wind quickly moved the effluent plume offshore. Future far-field monitoring possibilities will also depend upon whether the prevailing launch day winds carry the plume towards an area that is

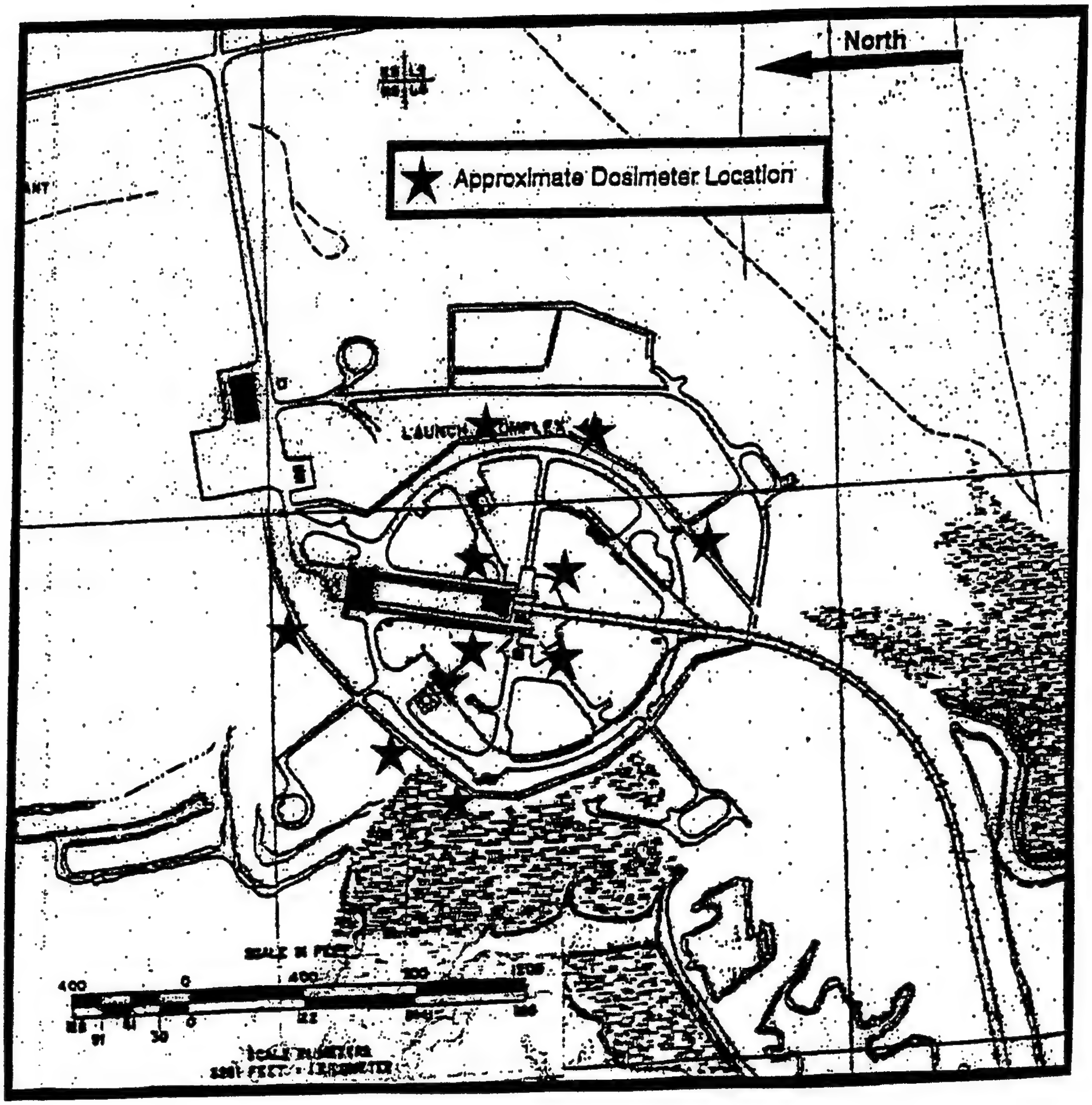


Figure 5. Locations of dosimeters during Titan IV launch on 22 Dec 1994.

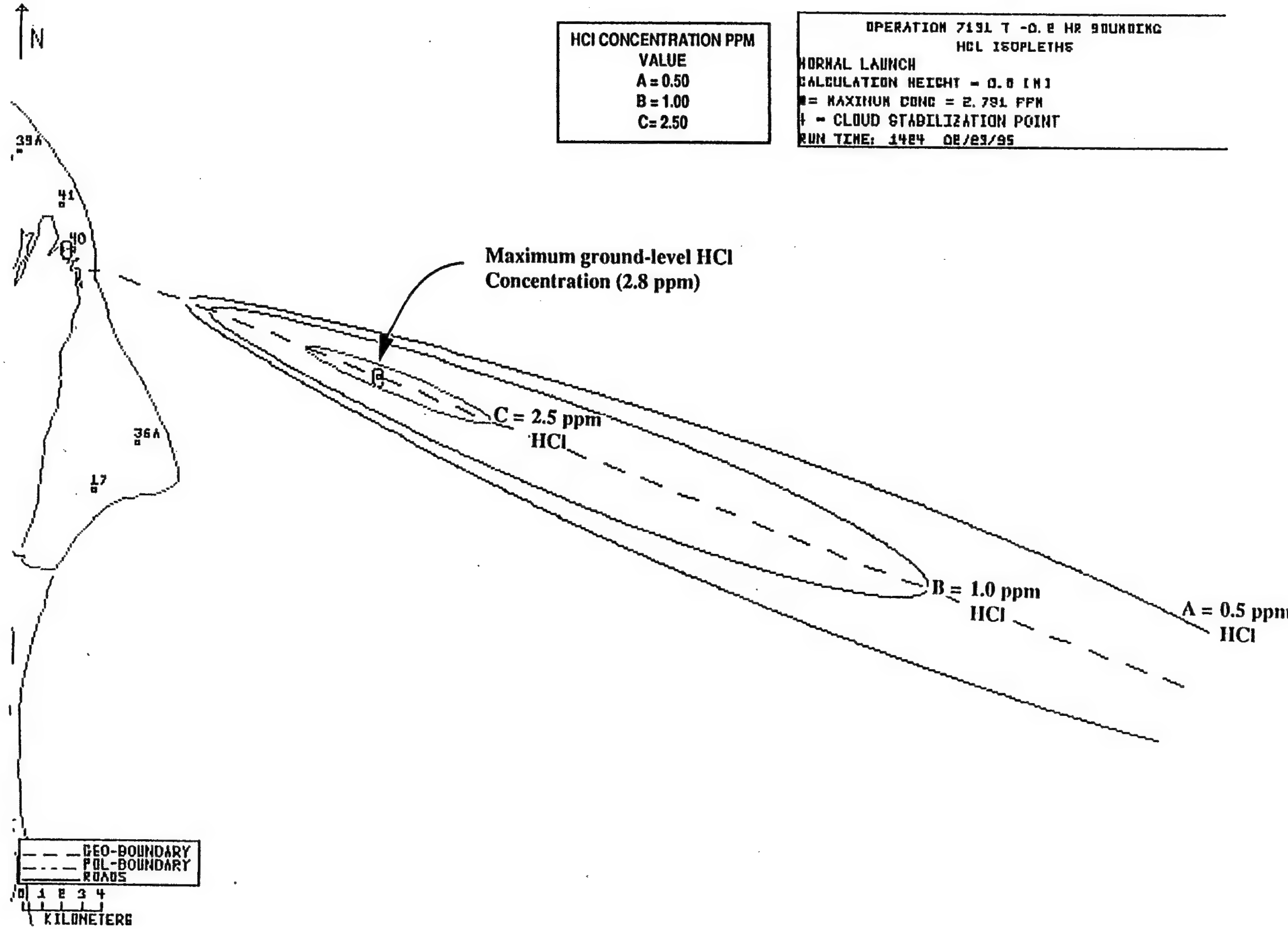


Figure 6. REEDM prediction of HCl concentration isopleths. Based on meteorological data determined at T-0.2 h.

accessible for detector/dosimeter placement. Measurements during the past three Titan launches have indicated less than 1 ppm or no detectable ground-level HCl in the near-field. Of the dosimeters deployed in the near-field during the 22 December launch, only those located on the four lightning towers showed a response. The response levels indicated are consistent with expectations. The lack of dosimeter response at the perimeter fence, on either side of the flame detection area, suggests that the plume follows a rather tight path during launch. These results were confirmed by the Geomet measurements at both ends of the berm as well as post launch observations.

Although only a limited number of Geomet analyzers have been deployed during the ground-level HCl measurements to date and the dosimeters' detection limit is 1 ppm-minute at best, the analyzers and dosimeters are performing accurately. Revised procedures have been implemented to allow more instrument deployment time and greater protection of the instruments from rain and humidity effects. This has enhanced instrument performance.

3.7 HCl Monitoring Recommendations and Plans

Although valuable information is being obtained in the ground-level HCl sampling effort, especially about the near field, many more field monitoring instruments are needed to finish characterizing the near field and to start the far field. Two real-time HCl concentration detectors (produced by Interscan and Enmet) are undergoing NASA/TVDL testing. Testing should be complete by April 1995. A minimum of 100 of the selected detectors should be purchased. This will enable accurate measurements of HCl ground concentration vs. time which is essential in verifying any model used to predict launch cloud behavior.

Dosimeter monitoring of future Titan IV launches will focus on far-field areas. The plume movement predicted at T - 4 hours will continue to be used to determine where dosimeters will be placed. Wind direction and weather conditions at launch time will determine how much data can be collected. Two dosimeters will be placed at each sampling site in the event of rain showers in the area. One will be equipped with the Teflon diffusion membrane and the other will be the more sensitive open-ended version. This will provide the best possibility for the collection of data even if rain and wind damage the open-ended dosimeter. During the period before the next launch, the TVDL will focus on qualification testing of the real-time detectors.

Work will continue to monitor every Titan IV launch using Geomet analyzers and dosimeters prior to procuring the additional detectors since all data are valuable.

Appendix A—The REEDM Code

[Material in this Appendix was contributed by Bart Lundblad of The Aerospace Corporation's Environmental Systems Directorate]

The Rocket Exhaust Effluent Diffusion Model (REEDM) is used by range safety offices at the Eastern and Western Ranges to predict toxic hazard corridors (THCs) for a variety of launch vehicles, including Titan and Delta. The code was developed in 1982 for the Air Force by H.E. Cramer Co. Development was based on the earlier NASA multi-layer diffusion model. REEDM is currently operated and periodically modified by a range safety contractor. The latest version can run on a personal computer in several minutes. REEDM calculates atmospheric toxic concentrations based on vehicle emission, meteorological, and launch scenario data provided by the user. Although based on relatively simple atmospheric dispersion physics, the code is complex with a large number of variables.

REEDM has not been fully validated and the accuracy of its concentration predictions has been questioned. Key factors determining predicted values include the cloud source terms, cloud rise and stabilization, cloud transport, cloud diffusion, and atmospheric chemistry.

- **Source Term:** REEDM predicts vehicle-specific initial cloud characteristics for both nominal launch and catastrophic failure cases. These characteristics include mass, temperature, buoyancy, and upward momentum. The model does not fully account for exhaust interaction with the launch mount and deluge water. It also does not account for HCl removal via washout, impingement, and rainout.

- **Cloud Rise and Stabilization:** REEDM uses the initial cloud characteristics and the meteorological profile to predict exhaust cloud rise and stabilization. The altitude of the predicted stabilization and the distribution of the cloud about the stabilization height are important determiners of predicted ground-level concentrations. Questions persist as to whether REEDM correctly predicts cloud stabilization heights, and if it properly accounts for cloud interaction with inversion layers that tend to inhibit cloud rise. It is also thought to inaccurately predict air entrainment rates and distribution of cloud mass.

- **Transport:** REEDM uses a single mean wind vector to predict the downwind trajectory of the stabilized cloud. The vector is calculated by averaging wind vectors from the measured wind profile. This simple method will not produce accurate cloud trajectories. In addition, REEDM does not account for changes in wind direction as the cloud moves downwind. Use of a single wind vector results in predictions of straight line cloud trajectory. This method cannot accurately portray true cloud movement.

- **Diffusion:** REEDM uses parameters of atmospheric turbulence to predict the rate at which toxic species in the elevated cloud will diffuse back down to ground-level. The

diffusion rate used by the model is crucial to the prediction of ground-level concentration isopleths. The simple Gaussian diffusion scheme used by REEDM is probably not valid for elevated cloud diffusion. The stabilized cloud may tend to remain elevated and not readily diffuse to ground-level.

- **Cloud Chemistry:** REEDM does not account for atmospheric chemical reactions of the launch cloud's toxic species. REEDM assumes that all HCl emitted remains in the cloud as gaseous HCl. There are important toxic removal processes occurring in the clouds that will reduce toxic ground-level concentrations. A valid model must account for these reactions.

Appendix B—Atmospheric Model Validation Program Activities

[Material in this Appendix was contributed by Bart Lundblad of The Aerospace Corporation's Environmental Systems Directorate]

The Atmospheric Dispersion Model Validation Program (MVP) is carrying out three major activities designed to validate REEDM: (A) the verification of REEDM's code, (B) the evaluation of REEDM's performance using empirical dispersion data, and (C) the establishment of the prediction confidence limits of REEDM based on the code and performance evaluations.

A. Code Verification

The REEDM code will be subjected to a rigorous review of its construction, equations, assumptions, default values, and uncertainties by a team of personnel with expertise in atmospheric modeling. This code verification process will provide a complete explanation of how the model uses input data to produce toxic concentration isopleths, including the inherent limitations that accompany these predictions. The code verification process will improve the understanding of the accuracy of code output and will provide essential information for ultimate model validation.

B. Model Performance Evaluation

The performance of REEDM in producing accurate toxic concentration predictions will be evaluated using empirical data collected during the monitoring of launch clouds and tracer gases. This evaluation process has three components: data collection, data archiving, and model comparison.

Data Collection: The launch ground clouds produced by nominal launches at the Eastern and Western Ranges will be monitored to collect data on cloud rise, growth, stabilization height, trajectory, diffusion, and toxic ground concentrations. Cloud monitoring will include remote imagery (visible, infrared, and lidar) and both aerial and ground sampling of cloud constituents.

Releases of tracer gas (non toxic, invisible, and inert) at the Eastern and Western Ranges will be employed to supplement the launch cloud monitoring data. The tracer gas will be released at various altitudes during non-launch periods to simulate sections of stabilized toxic cloud. The puffs and plumes of tracer gas will be remotely imaged with infrared cameras and lidars and also detected in the air and at ground level. The tracer release activity will provide valuable information on cloud trajectory and diffusion patterns in the coastal environments at the ranges. Tracer release sessions will be conducted during different seasons of the year to account for seasonal variations in dispersion characteristics.

An important part of the field data collection activity is the production of a complimentary meteorological data package that can be used to evaluate the meteorological portions of REEDM. Data provided by the existing range meteorological network will be supple-

mented, as necessary, by the MVP to ensure that all necessary meteorological data is collected.

Data Archiving: A computerized data storage system will be created to archive cloud dispersion and meteorological data collected during the field activities. The data will be reviewed and reduced prior to archiving. The system will enable a rapid and accurate delivery of requested data to REEDM evaluators. The archive will remain as a valuable resource to be utilized during the evaluations of future range dispersion models.

Model Comparison: Model evaluators will run REEDM using archived meteorological data and compare its output with the empirical cloud dispersion data collected during the field activities. The cloud imagery data will be used to evaluate how closely REEDM can simulate cloud rise growth, and stabilization. Imagery and aerial sampling of the launch and tracer clouds will permit evaluation of cloud trajectory and diffusion. The ground sampling data will allow a direct comparison between REEDM toxic concentration isopleths and the actual gas concentration detected at ground level. The aerial and ground sampling will also provide real cloud chemical composition data that will assist evaluation of atmospheric chemical reactions and conversions. The evaluation team will report on the overall accuracy of the REEDM predictions as well as the accuracy of each REEDM component: cloud rise, transport, diffusion, and ground concentration.

C. Establishment of Confidence Limits

The MVP will use the knowledge gained from the REEDM code examination and the REEDM performance evaluation to establish confidence limits for REEDM use and thereby validate REEDM. These confidence limits will be based on REEDM's strengths and weaknesses and will provide guidance on interpretation of model predictions. Establishment of the confidence limits will validate REEDM by providing a firm basis for REEDM use at the ranges.

Appendix C—HCl Dosimeter Development

[Material in this Appendix was abstracted from material prepared by Dale Lueck, Dan Curran, and Barry Meneghelli of NASA's Toxic Vapor Detection Laboratory.]

A major effort to reduce the lower detection threshold of the HCl dosimeter has been the primary focus of NASA's Toxic Vapor Detection Laboratory in the interim period since the last Titan IV launch at CCAS on 27 August 1994. Essentially every attribute of the dosimeter was evaluated to maximize the sensitivity of the device to HCl vapor.

1. Optimization of the dye neutralization point.
2. Use of a smaller diameter dye stain tube.
3. Decreasing the amount of dye sprayed on stain tubes.
4. Use of a larger outer dosimeter cover.
5. Use of a larger pore size Teflon membrane.
6. Use of bromothymol blue dye instead of bromophenol blue.
7. Use of polyvinyl chloride binder instead of polyvinyl alcohol.
8. Fabrication of diffusion holes in the Teflon membrane.
9. Active pumping of the sample into the dosimeter.

The resulting dosimeter allows HCl vapor measurements down to 1 ppm-min. (Figure C1). The dye formulation was changed from fully neutralized to 60% neutralized. The outer diameter of the stain tube was reduced from 0.110" to 0.035". The amount of dye applied to the stain tube was reduced by 50%. An increase in the sensitivity of the dosimeter was achieved by enlarging the outer cover, but was offset by the increased response scatter due to air velocity effects. Most velocity effects can be eliminated through the use of a Teflon diffusion membrane over the opening of the dosimeter, but the membrane tends to decrease sensitivity. The larger pore size Teflon membrane showed better sensitivity when compared to the smaller pore size, but overall the response threshold of the open-ended version could not be equaled with any dosimeter design tested that incorporated the Teflon diffusion membrane. Although significant gains were made in the slope of the response curve (larger length of stain for the same dose), very little improvement was made in the detection threshold (lowest detectable dose). None of the other modifications evaluated resulted in significantly lower levels of sensitivity of the dosimeter.

Dosimeters fitted with Teflon diffusion membranes were used for ground-level HCl monitoring on the day of the actual #K14 Titan IV launch (22 December 1994) because of that day's rainy weather conditions. The dosimeters do not provide maximum sensitivity when the diffusion membrane is used. The membrane, however, does prevent moisture from being blown into the dosimeter, dissolving the dye, and causing the loss of collected data. The calibration graph of the dosimeters which were deployed is shown in Figure C2.

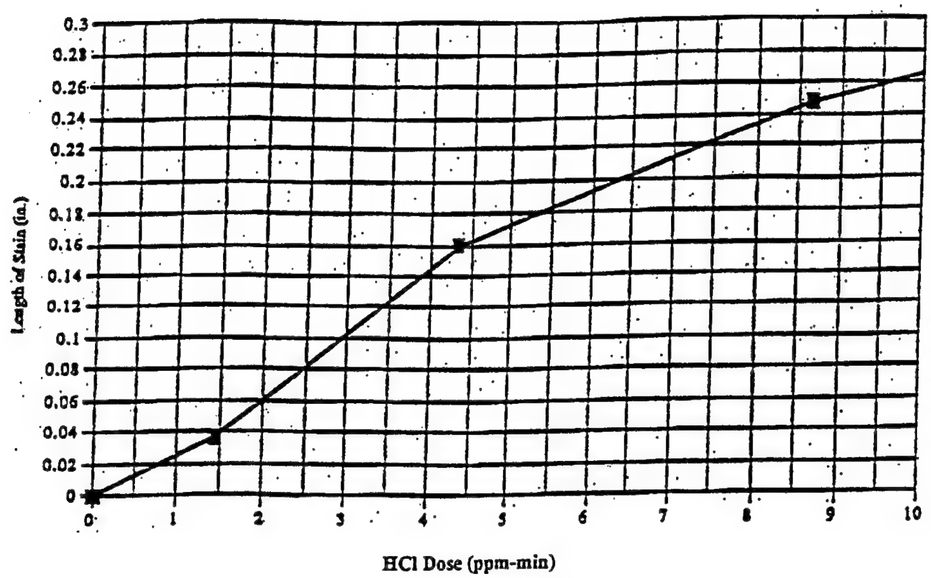


Figure C1. Average calibration curve from set of five improved HCl passive dosimeters.

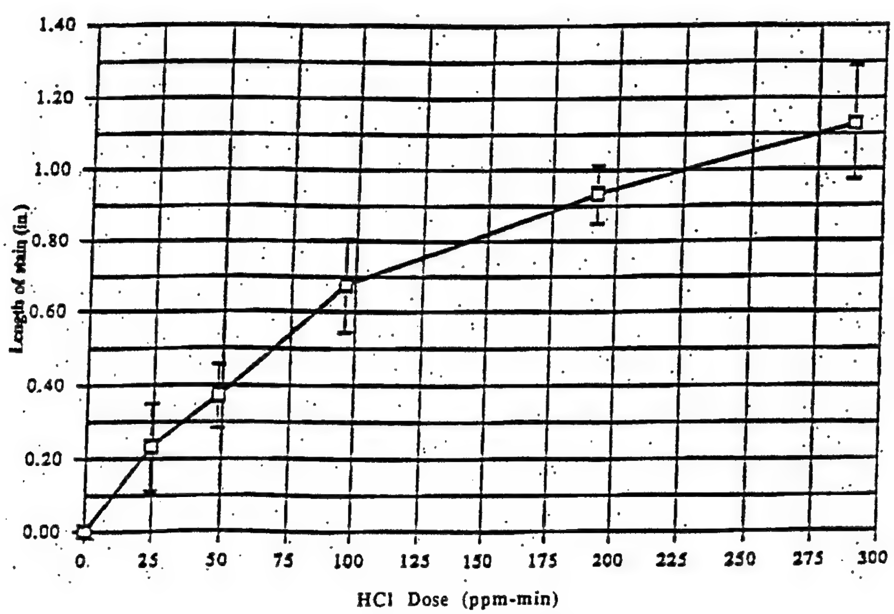


Figure C2. Calibration data for five dosimeters from lot deployed during 22 Dec 94 Titan IV launch. Error bars represent two standard deviations.

Appendix D—Meteorological Data Measured at CCAS Before and After the #K14 Launch

[Material in this Appendix was contributed by Douglas Schulthess of the Aerospace Corporation's Eastern Range Systems Engineering Directorate, Randy Evans of Ensco, Inc.'s Applied Meteorology Unit, and Hal Herring of Computer Sciences Raytheon.]

Meteorological data were measured at a number of CCAS monitoring locations prior to launch and during development and dispersion of the launch cloud. Representative data of two different types are tabulated here. Data are first presented for meteorological measurements performed at various Zulu times (**TIME**) at numerous meteorological towers [designated by their latitudinal and longitudinal positions in degrees (**LAT** and **LON**, respectively)] at various elevations (**Z**) in feet. It is noted that the #K14 launch occurred at 22:19 Zulu time (Zulu time is EST + 5 hours). Data are presented on the wind direction in degrees azimuth (**DIR**), the wind speed in knots (**SPD**), and the ambient and dew point temperatures in degrees Fahrenheit (**T** and **TD**, respectively) at these locations. Rawinsonde data collected at various Zulu times are presented next. Here altitude (**ALT**) is expressed in geometric feet, **I/R** is the measure of the refractive index of air, **V/S** is the speed of sound in air in knots at the indicated altitude, **VPS** the saturation vapor pressure of water at the temperature measured at the given altitude, and **PW** is the precipitable water in the vertical column of air leading up to the altitude indicated. More complete tabulations of these meteorological data are available from Gary Loper of The Aerospace Corporation, phone (310) 336-4513.

METEOROLOGICAL TOWER DATA AT 19:50:00 ZULU TIME (T - 2 hours and 29 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	195000	28.4330	80.5712	6			61	
94356	195000	28.4330	80.5712	12	316	3		
94356	195000	28.4330	80.5712	54	324	6	61	
94356	195000	28.4598	80.5267	6			60	
94356	195000	28.4598	80.5267	12	303	5		
94356	195000	28.4598	80.5267	54	296	7	61	
94356	195000	28.4997	80.5487	6				
94356	195000	28.4997	80.5487	12				
94356	195000	28.4997	80.5487	54				
94356	195000	28.4997	80.5487	162				
94356	195000	28.4997	80.5487	204				
94356	195000	28.5361	80.5732	6			61	
94356	195000	28.5361	80.5732	12	292	4		
94356	195000	28.5361	80.5732	54	306	6	60	
94356	195000	28.5698	80.5836	6			62	60
94356	195000	28.5698	80.5836	12	317	6		
94356	195000	28.5698	80.5836	54	324	9	62	61
94356	195000	28.5698	80.5836	162	310	10		
94356	195000	28.5698	80.5836	204	317	10	60	
94356	195000	28.6139	80.6136	6			62	
94356	195000	28.6139	80.6136	12	336	6		
94356	195000	28.6139	80.6136	54	326	7	61	
94356	195000	28.4605	80.5697	6			61	
94356	195000	28.4605	80.5697	12	301	2		
94356	195000	28.4605	80.5697	54	308	4	60	
94356	195000	28.6026	80.6320	6			61	
94356	195000	28.6026	80.6320	12	321	3		
94356	195000	28.6026	80.6320	54	0	0	60	
94356	195000	28.6253	80.6459	6			61	57
94356	195000	28.6253	80.6459	12	295	5		
94356	195000	28.6253	80.6459	54	279	8	61	56
94356	195000	28.6253	80.6459	162	289	11		
94356	195000	28.6253	80.6459	204	288	12	61	56
94356	195000	28.6253	80.6459	295	301	13		
94356	195000	28.6253	80.6459	394	289	13		
94356	195000	28.6253	80.6459	492	292	13	59	56
94356	195000	28.4585	80.5904	6			62	
94356	195000	28.4585	80.5904	12	321	4		
94356	195000	28.4585	80.5904	54	304	8	60	
94356	195000	28.6060	80.6606	6			61	
94356	195000	28.6060	80.6606	12	285	3		
94356	195000	28.6060	80.6606	54	288	6	60	
94356	195000	28.6581	80.6836	6			61	
94356	195000	28.6581	80.6836	12	290	4		
94356	195000	28.6581	80.6836	54			61	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	195000	28.5160	80.6306	6			61	
94356	195000	28.5160	80.6306	12	291	4		
94356	195000	28.5160	80.6306	54	292	4	59	
94356	195000	28.5622	80.6566	6			61	
94356	195000	28.5622	80.6566	12	0	0		
94356	195000	28.5622	80.6566	54				
94356	195000	28.6426	80.7261	6			62	
94356	195000	28.6426	80.7261	12	320	2		
94356	195000	28.6426	80.7261	54	312	6	61	
94356	195000	28.4634	80.6570	6				
94356	195000	28.4634	80.6570	12				
94356	195000	28.4634	80.6570	54				
94356	195000	28.7356	80.7321	6				
94356	195000	28.7356	80.7321	60				
94356	195000	28.6860	80.7017	6				
94356	195000	28.6860	80.7017	60				
94356	195000	28.5268	80.7538	6				
94356	195000	28.5268	80.7538	30	292	3		
94356	195000	28.5542	80.6850	6				
94356	195000	28.5542	80.6850	54	302	6		
94356	195000	28.5180	80.6800	6				
94356	195000	28.5180	80.6800	54	302	5		
94356	195000	28.6052	80.7938	6				
94356	195000	28.6052	80.7938	54	259	4		
94356	195000	28.5416	80.7814	6				
94356	195000	28.5416	80.7814	54				
94356	195000	28.6309	80.6860	6				
94356	195000	28.6309	80.6860	30	290	7		
94356	195000	28.5983	80.6677	6				
94356	195000	28.5983	80.6677	30	298	6		
94356	195000	28.6148	80.6773	6			61	58
94356	195000	28.6148	80.6773	30	304	6		
94356	195000	28.6081	80.5997	6				
94356	195000	28.6081	80.5997	295				
94356	195000	28.6081	80.5997	6				
94356	195000	28.6081	80.5997	295				
94356	195000	28.6104	80.6024	6				
94356	195000	28.6104	80.6024	60	307	12		
94356	195000	28.6057	80.5970	6			61	57
94356	195000	28.6057	80.5970	60	301	9		

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	195000	28.6267	80.6207	6				
94356	195000	28.6267	80.6207	295				
94356	195000	28.6286	80.6238	6			60	
94356	195000	28.6286	80.6238	60	308	11		
94356	195000	28.6244	80.6184	6			60	57
94356	195000	28.6244	80.6184	60	318	8		

METEOROLOGICAL TOWER DATA AT 20:50:00 ZULU TIME (T - 1 hour and 29 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	205000	28.4330	80.5712	6			61	
94356	205000	28.4330	80.5712	12	295	3		
94356	205000	28.4330	80.5712	54	304	8	60	
94356	205000	28.4598	80.5267	6			60	
94356	205000	28.4598	80.5267	12	301	5		
94356	205000	28.4598	80.5267	54	296	7	61	
94356	205000	28.4997	80.5487	6				
94356	205000	28.4997	80.5487	12				
94356	205000	28.4997	80.5487	54				
94356	205000	28.4997	80.5487	162				
94356	205000	28.4997	80.5487	204				
94356	205000	28.5361	80.5732	6			62	
94356	205000	28.5361	80.5732	12	286	4		
94356	205000	28.5361	80.5732	54	300	7	60	
94356	205000	28.5698	80.5836	6			62	60
94356	205000	28.5698	80.5836	12	309	5		
94356	205000	28.5698	80.5836	54	311	8	62	61
94356	205000	28.5698	80.5836	162	302	8		
94356	205000	28.5698	80.5836	204	310	9	60	
94356	205000	28.6139	80.6136	6			62	
94356	205000	28.6139	80.6136	12	300	3		
94356	205000	28.6139	80.6136	54	297	6	61	
94356	205000	28.4605	80.5697	6			62	
94356	205000	28.4605	80.5697	12	304	4		
94356	205000	28.4605	80.5697	54	303	2	60	
94356	205000	28.6026	80.6320	6			61	
94356	205000	28.6026	80.6320	12	297	3		
94356	205000	28.6026	80.6320	54	0	0	60	
94356	205000	28.6253	80.6459	6			61	56
94356	205000	28.6253	80.6459	12	311	4		
94356	205000	28.6253	80.6459	54	285	5	61	56
94356	205000	28.6253	80.6459	162	290	7		
94356	205000	28.6253	80.6459	204	285	8	61	56
94356	205000	28.6253	80.6459	295	293	9		
94356	205000	28.6253	80.6459	394	283	10		
94356	205000	28.6253	80.6459	492	281	10	59	56
94356	205000	28.4585	80.5904	6			62	
94356	205000	28.4585	80.5904	12	317	4		
94356	205000	28.4585	80.5904	54	299	7	60	
94356	205000	28.6060	80.6606	6			60	
94356	205000	28.6060	80.6606	12	271	3		
94356	205000	28.6060	80.6606	54	272	4	60	
94356	205000	28.6581	80.6836	6			61	
94356	205000	28.6581	80.6836	12	288	2		
94356	205000	28.6581	80.6836	54			61	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	205000	28.5160	80.6306	6			61	
94356	205000	28.5160	80.6306	12	280	4		
94356	205000	28.5160	80.6306	54	279	5	60	
94356	205000	28.5622	80.6566	6			61	
94356	205000	28.5622	80.6566	12	0	0		
94356	205000	28.5622	80.6566	54			60	
94356	205000	28.6426	80.7261	6			61	
94356	205000	28.6426	80.7261	12	280	2		
94356	205000	28.6426	80.7261	54	289	8	61	
94356	205000	28.4634	80.6570	6				
94356	205000	28.4634	80.6570	12				
94356	205000	28.4634	80.6570	54				
94356	205000	28.7356	80.7321	6				
94356	205000	28.7356	80.7321	60				
94356	205000	28.6860	80.7017	6				
94356	205000	28.6860	80.7017	60				
94356	205000	28.5268	80.7538	6				
94356	205000	28.5268	80.7538	30	285	5		
94356	205000	28.5542	80.6850	6				
94356	205000	28.5542	80.6850	54	302	9		
94356	205000	28.5180	80.6800	6				
94356	205000	28.5180	80.6800	54	280	6		
94356	205000	28.6052	80.7938	6				
94356	205000	28.6052	80.7938	54	276	3		
94356	205000	28.5416	80.7814	6				
94356	205000	28.5416	80.7814	54				
94356	205000	28.6309	80.6860	6				
94356	205000	28.6309	80.6860	30				
94356	205000	28.5983	80.6677	6				
94356	205000	28.5983	80.6677	30				
94356	205000	28.6148	80.6773	6				
94356	205000	28.6148	80.6773	30				
94356	205000	28.6081	80.5997	6				
94356	205000	28.6081	80.5997	295				
94356	205000	28.6081	80.5997	6				
94356	205000	28.6081	80.5997	295				
94356	205000	28.6104	80.6024	6				
94356	205000	28.6104	80.6024	60				
94356	205000	28.6057	80.5970	6				
94356	205000	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	205000	28.6267	80.6207	6				
94356	205000	28.6267	80.6207	295				
94356	205000	28.6286	80.6238	6				
94356	205000	28.6286	80.6238	60				
94356	205000	28.6244	80.6184	6				
94356	205000	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 21:55:00 ZULU TIME (T - 24 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	215500	28.4330	80.5712	6			60	
94356	215500	28.4330	80.5712	12	305	3		
94356	215500	28.4330	80.5712	54	312	6	60	
94356	215500	28.4598	80.5267	6			60	
94356	215500	28.4598	80.5267	12	315	4		
94356	215500	28.4598	80.5267	54	306	5	61	
94356	215500	28.4997	80.5487	6				
94356	215500	28.4997	80.5487	12				
94356	215500	28.4997	80.5487	54				
94356	215500	28.4997	80.5487	162				
94356	215500	28.4997	80.5487	204				
94356	215500	28.5361	80.5732	6			61	
94356	215500	28.5361	80.5732	12	295	3		
94356	215500	28.5361	80.5732	54	307	5	59	
94356	215500	28.5698	80.5836	6			61	
94356	215500	28.5698	80.5836	12	303	3		
94356	215500	28.5698	80.5836	54	302	5	61	60
94356	215500	28.5698	80.5836	162	294	5		
94356	215500	28.5698	80.5836	204	303	6	59	
94356	215500	28.6139	80.6136	6			61	
94356	215500	28.6139	80.6136	12	289	3		
94356	215500	28.6139	80.6136	54	289	5	61	
94356	215500	28.4605	80.5697	6			61	
94356	215500	28.4605	80.5697	12	301	3		
94356	215500	28.4605	80.5697	54	294	4	60	
94356	215500	28.6026	80.6320	6			60	
94356	215500	28.6026	80.6320	12	300	2		
94356	215500	28.6026	80.6320	54	0	0	60	
94356	215500	28.6253	80.6459	6			60	56
94356	215500	28.6253	80.6459	12	295	3		
94356	215500	28.6253	80.6459	54	281	5	60	56
94356	215500	28.6253	80.6459	162	286	7		
94356	215500	28.6253	80.6459	204	284	7	60	56
94356	215500	28.6253	80.6459	295	296	8		
94356	215500	28.6253	80.6459	394	289	8		
94356	215500	28.6253	80.6459	492	292	9	58	55
94356	215500	28.4585	80.5904	6			62	
94356	215500	28.4585	80.5904	12	314	3		
94356	215500	28.4585	80.5904	54	295	6	60	
94356	215500	28.6060	80.6606	6			60	
94356	215500	28.6060	80.6606	12	268	2		
94356	215500	28.6060	80.6606	54	281	3	59	
94356	215500	28.6581	80.6836	6			60	
94356	215500	28.6581	80.6836	12	277	2		
94356	215500	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	215500	28.5160	80.6306	6			60	
94356	215500	28.5160	80.6306	12	295	3		
94356	215500	28.5160	80.6306	54	297	4	59	
94356	215500	28.5622	80.6566	6			60	
94356	215500	28.5622	80.6566	12	0	0		
94356	215500	28.5622	80.6566	54			60	
94356	215500	28.6426	80.7261	6			61	
94356	215500	28.6426	80.7261	12	312	1		
94356	215500	28.6426	80.7261	54	304	4	61	
94356	215500	28.4634	80.6570	6				
94356	215500	28.4634	80.6570	12				
94356	215500	28.4634	80.6570	54				
94356	215500	28.7356	80.7321	6				
94356	215500	28.7356	80.7321	60				
94356	215500	28.6860	80.7017	6				
94356	215500	28.6860	80.7017	60				
94356	215500	28.5268	80.7538	6				
94356	215500	28.5268	80.7538	30	300	2		
94356	215500	28.5542	80.6850	6				
94356	215500	28.5542	80.6850	54	310	5		
94356	215500	28.5180	80.6800	6				
94356	215500	28.5180	80.6800	54	288	5		
94356	215500	28.6052	80.7938	6				
94356	215500	28.6052	80.7938	54	263	2		
94356	215500	28.5416	80.7814	6				
94356	215500	28.5416	80.7814	54				
94356	215500	28.6309	80.6860	6				
94356	215500	28.6309	80.6860	30				
94356	215500	28.5983	80.6677	6				
94356	215500	28.5983	80.6677	30				
94356	215500	28.6148	80.6773	6				
94356	215500	28.6148	80.6773	30				
94356	215500	28.6081	80.5997	6				
94356	215500	28.6081	80.5997	295				
94356	215500	28.6081	80.5997	6				
94356	215500	28.6081	80.5997	295				
94356	215500	28.6104	80.6024	6				
94356	215500	28.6104	80.6024	60				
94356	215500	28.6057	80.5970	6				
94356	215500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	215500	28.6267	80.6207	6				
94356	215500	28.6267	80.6207	295				
94356	215500	28.6286	80.6238	6				
94356	215500	28.6286	80.6238	60				
94356	215500	28.6244	80.6184	6				
94356	215500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:15:00 ZULU TIME (T - 4 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	221500	28.4330	80.5712	6			60	
94356	221500	28.4330	80.5712	12	298	2		
94356	221500	28.4330	80.5712	54	305	5	60	
94356	221500	28.4598	80.5267	6			60	
94356	221500	28.4598	80.5267	12	298	3		
94356	221500	28.4598	80.5267	54	291	4	61	
94356	221500	28.4997	80.5487	6				
94356	221500	28.4997	80.5487	12				
94356	221500	28.4997	80.5487	54				
94356	221500	28.4997	80.5487	162				
94356	221500	28.4997	80.5487	204				
94356	221500	28.5361	80.5732	6			61	
94356	221500	28.5361	80.5732	12	286	3		
94356	221500	28.5361	80.5732	54	293	4	59	
94356	221500	28.5698	80.5836	6			61.	
94356	221500	28.5698	80.5836	12	295	3		
94356	221500	28.5698	80.5836	54	293	4	61	61
94356	221500	28.5698	80.5836	162	284	4		
94356	221500	28.5698	80.5836	204	294	5	60	
94356	221500	28.6139	80.6136	6			61	
94356	221500	28.6139	80.6136	12	266	3		
94356	221500	28.6139	80.6136	54	271	4	61	
94356	221500	28.4605	80.5697	6			61	
94356	221500	28.4605	80.5697	12	306	2		
94356	221500	28.4605	80.5697	54	301	3	60	
94356	221500	28.6026	80.6320	6			60	
94356	221500	28.6026	80.6320	12	282	2		
94356	221500	28.6026	80.6320	54	0	0	60	
94356	221500	28.6253	80.6459	6			60	56
94356	221500	28.6253	80.6459	12	281	2		
94356	221500	28.6253	80.6459	54	259	4	60	56
94356	221500	28.6253	80.6459	162	265	6		
94356	221500	28.6253	80.6459	204	264	6	60	56
94356	221500	28.6253	80.6459	295	274	6		
94356	221500	28.6253	80.6459	394	269	8		
94356	221500	28.6253	80.6459	492	272	8	58	55
94356	221500	28.4585	80.5904	6			61	
94356	221500	28.4585	80.5904	12	318	3		
94356	221500	28.4585	80.5904	54	300	5	60	
94356	221500	28.6060	80.6606	6			60	
94356	221500	28.6060	80.6606	12	270	1		
94356	221500	28.6060	80.6606	54	275	2	59	
94356	221500	28.6581	80.6836	6			60	
94356	221500	28.6581	80.6836	12	282	1		
94356	221500	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	221500	28.5160	80.6306	6			60	
94356	221500	28.5160	80.6306	12	290	3		
94356	221500	28.5160	80.6306	54	286	3	59	
94356	221500	28.5622	80.6566	6			60	
94356	221500	28.5622	80.6566	12	0	0		
94356	221500	28.5622	80.6566	54			60	
94356	221500	28.6426	80.7261	6			61	
94356	221500	28.6426	80.7261	12	310	1		
94356	221500	28.6426	80.7261	54	307	7	60	
94356	221500	28.4634	80.6570	6				
94356	221500	28.4634	80.6570	12				
94356	221500	28.4634	80.6570	54				
94356	221500	28.7356	80.7321	6				
94356	221500	28.7356	80.7321	60				
94356	221500	28.6860	80.7017	6				
94356	221500	28.6860	80.7017	60				
94356	221500	28.5268	80.7538	6				
94356	221500	28.5268	80.7538	30	313	1		
94356	221500	28.5542	80.6850	6				
94356	221500	28.5542	80.6850	54	288	5		
94356	221500	28.5180	80.6800	6				
94356	221500	28.5180	80.6800	54	284	3		
94356	221500	28.6052	80.7938	6				
94356	221500	28.6052	80.7938	54	274	2		
94356	221500	28.5416	80.7814	6				
94356	221500	28.5416	80.7814	54				
94356	221500	28.6309	80.6860	6				
94356	221500	28.6309	80.6860	30				
94356	221500	28.5983	80.6677	6				
94356	221500	28.5983	80.6677	30				
94356	221500	28.6148	80.6773	6				
94356	221500	28.6148	80.6773	30				
94356	221500	28.6081	80.5997	6				
94356	221500	28.6081	80.5997	295				
94356	221500	28.6081	80.5997	6				
94356	221500	28.6081	80.5997	295				
94356	221500	28.6104	80.6024	6				
94356	221500	28.6104	80.6024	60				
94356	221500	28.6057	80.5970	6				
94356	221500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	221500	28.6267	80.6207	6				
94356	221500	28.6267	80.6207	295				
94356	221500	28.6286	80.6238	6				
94356	221500	28.6286	80.6238	60				
94356	221500	28.6244	80.6184	6				
94356	221500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:20:00 ZULU TIME (T + 1 minute)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	222000	28.4330	80.5712	6			60	
94356	222000	28.4330	80.5712	12	302	2		
94356	222000	28.4330	80.5712	54	315	5	60	
94356	222000	28.4598	80.5267	6			60	
94356	222000	28.4598	80.5267	12	299	3		
94356	222000	28.4598	80.5267	54	297	5	61	
94356	222000	28.4997	80.5487	6				
94356	222000	28.4997	80.5487	12				
94356	222000	28.4997	80.5487	54				
94356	222000	28.4997	80.5487	162				
94356	222000	28.4997	80.5487	204				
94356	222000	28.5361	80.5732	6			61	
94356	222000	28.5361	80.5732	12	270	3		
94356	222000	28.5361	80.5732	54	281	6	59	
94356	222000	28.5698	80.5836	6			61	
94356	222000	28.5698	80.5836	12	298	2		
94356	222000	28.5698	80.5836	54	297	4	61	60
94356	222000	28.5698	80.5836	162	287	4		
94356	222000	28.5698	80.5836	204	296	5	60	
94356	222000	28.6139	80.6136	6			61	
94356	222000	28.6139	80.6136	12	266	3		
94356	222000	28.6139	80.6136	54	271	5	61	
94356	222000	28.4605	80.5697	6			61	
94356	222000	28.4605	80.5697	12	325	2		
94356	222000	28.4605	80.5697	54	312	4	60	
94356	222000	28.6026	80.6320	6			60	
94356	222000	28.6026	80.6320	12	271	1		
94356	222000	28.6026	80.6320	54			60	
94356	222000	28.6253	80.6459	6			60	56
94356	222000	28.6253	80.6459	12	273	3		
94356	222000	28.6253	80.6459	54	257	4	60	56
94356	222000	28.6253	80.6459	162	268	6		
94356	222000	28.6253	80.6459	204	266	7	60	56
94356	222000	28.6253	80.6459	295	280	7		
94356	222000	28.6253	80.6459	394	275	9		
94356	222000	28.6253	80.6459	492	274	9	58	55
94356	222000	28.4585	80.5904	6			62	
94356	222000	28.4585	80.5904	12	321	3		
94356	222000	28.4585	80.5904	54	301	5	61	
94356	222000	28.6060	80.6606	6			60	
94356	222000	28.6060	80.6606	12	283	1		
94356	222000	28.6060	80.6606	54	284	2	59	
94356	222000	28.6581	80.6836	6			60	
94356	222000	28.6581	80.6836	12	277	1		
94356	222000	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	222000	28.5160	80.6306	6			60	
94356	222000	28.5160	80.6306	12	297	3		
94356	222000	28.5160	80.6306	54	292	3	59	
94356	222000	28.5622	80.6566	6			60	
94356	222000	28.5622	80.6566	12	0	0		
94356	222000	28.5622	80.6566	54			60	
94356	222000	28.6426	80.7261	6			61	
94356	222000	28.6426	80.7261	12	303	1		
94356	222000	28.6426	80.7261	54	298	4	61	
94356	222000	28.4634	80.6570	6				
94356	222000	28.4634	80.6570	12				
94356	222000	28.4634	80.6570	54				
94356	222000	28.7356	80.7321	6				
94356	222000	28.7356	80.7321	60				
94356	222000	28.6860	80.7017	6				
94356	222000	28.6860	80.7017	60				
94356	222000	28.5268	80.7538	6				
94356	222000	28.5268	80.7538	30	320	1		
94356	222000	28.5542	80.6850	6				
94356	222000	28.5542	80.6850	54	283	5		
94356	222000	28.5180	80.6800	6				
94356	222000	28.5180	80.6800	54	284	4		
94356	222000	28.6052	80.7938	6				
94356	222000	28.6052	80.7938	54	290	2		
94356	222000	28.5416	80.7814	6				
94356	222000	28.5416	80.7814	54				
94356	222000	28.6309	80.6860	6				
94356	222000	28.6309	80.6860	30				
94356	222000	28.5983	80.6677	6				
94356	222000	28.5983	80.6677	30				
94356	222000	28.6148	80.6773	6				
94356	222000	28.6148	80.6773	30				
94356	222000	28.6081	80.5997	6				
94356	222000	28.6081	80.5997	295				
94356	222000	28.6081	80.5997	6				
94356	222000	28.6081	80.5997	295				
94356	222000	28.6104	80.6024	6				
94356	222000	28.6104	80.6024	60				
94356	222000	28.6057	80.5970	6				
94356	222000	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	222000	28.6267	80.6207	6				
94356	222000	28.6267	80.6207	295				
94356	222000	28.6286	80.6238	6				
94356	222000	28.6286	80.6238	60				
94356	222000	28.6244	80.6184	6				
94356	222000	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:25:00 ZULU TIME (T + 6 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	222500	28.4330	80.5712	6			60	
94356	222500	28.4330	80.5712	12	305	2		
94356	222500	28.4330	80.5712	54	319	4	60	
94356	222500	28.4598	80.5267	6			59	
94356	222500	28.4598	80.5267	12	314	3		
94356	222500	28.4598	80.5267	54	311	5	60	
94356	222500	28.4997	80.5487	6				
94356	222500	28.4997	80.5487	12				
94356	222500	28.4997	80.5487	54				
94356	222500	28.4997	80.5487	162				
94356	222500	28.4997	80.5487	204				
94356	222500	28.5361	80.5732	6			61	
94356	222500	28.5361	80.5732	12	279	3		
94356	222500	28.5361	80.5732	54	290	6	59	
94356	222500	28.5698	80.5836	6			61	
94356	222500	28.5698	80.5836	12	296	2		
94356	222500	28.5698	80.5836	54	292	4	61	59
94356	222500	28.5698	80.5836	162	282	4		
94356	222500	28.5698	80.5836	204	293	5	60	
94356	222500	28.6139	80.6136	6			61	
94356	222500	28.6139	80.6136	12	270	3		
94356	222500	28.6139	80.6136	54	274	4	61	
94356	222500	28.4605	80.5697	6			61	
94356	222500	28.4605	80.5697	12	317	1		
94356	222500	28.4605	80.5697	54	321	4	60	
94356	222500	28.6026	80.6320	6			60	
94356	222500	28.6026	80.6320	12	276	1		
94356	222500	28.6026	80.6320	54	0	0	60	
94356	222500	28.6253	80.6459	6			60	56
94356	222500	28.6253	80.6459	12	290	3		
94356	222500	28.6253	80.6459	54	269	5	60	56
94356	222500	28.6253	80.6459	162	277	7		
94356	222500	28.6253	80.6459	204	276	7	60	56
94356	222500	28.6253	80.6459	295	287	8		
94356	222500	28.6253	80.6459	394	278	9		
94356	222500	28.6253	80.6459	492	276	9	58	55
94356	222500	28.4585	80.5904	6			61	
94356	222500	28.4585	80.5904	12	314	3		
94356	222500	28.4585	80.5904	54	298	5	60	
94356	222500	28.6060	80.6606	6			60	
94356	222500	28.6060	80.6606	12	289	1		
94356	222500	28.6060	80.6606	54	291	3	59	
94356	222500	28.6581	80.6836	6			60	
94356	222500	28.6581	80.6836	12	278	1		
94356	222500	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	222500	28.5160	80.6306	6			60	
94356	222500	28.5160	80.6306	12	299	3		
94356	222500	28.5160	80.6306	54	291	3	59	
94356	222500	28.5622	80.6566	6			60	
94356	222500	28.5622	80.6566	12	0	0		
94356	222500	28.5622	80.6566	54			60	
94356	222500	28.6426	80.7261	6			61	
94356	222500	28.6426	80.7261	12	309	1		
94356	222500	28.6426	80.7261	54	295	4	61	
94356	222500	28.4634	80.6570	6				
94356	222500	28.4634	80.6570	12				
94356	222500	28.4634	80.6570	54				
94356	222500	28.7356	80.7321	6				
94356	222500	28.7356	80.7321	60				
94356	222500	28.6860	80.7017	6				
94356	222500	28.6860	80.7017	60				
94356	222500	28.5268	80.7538	6				
94356	222500	28.5268	80.7538	30	314	1		
94356	222500	28.5542	80.6850	6				
94356	222500	28.5542	80.6850	54	289	5		
94356	222500	28.5180	80.6800	6				
94356	222500	28.5180	80.6800	54	281	3		
94356	222500	28.6052	80.7938	6				
94356	222500	28.6052	80.7938	54	284	3		
94356	222500	28.5416	80.7814	6				
94356	222500	28.5416	80.7814	54				
94356	222500	28.6309	80.6860	6				
94356	222500	28.6309	80.6860	30				
94356	222500	28.5983	80.6677	6				
94356	222500	28.5983	80.6677	30				
94356	222500	28.6148	80.6773	6				
94356	222500	28.6148	80.6773	30				
94356	222500	28.6081	80.5997	6				
94356	222500	28.6081	80.5997	295				
94356	222500	28.6081	80.5997	6				
94356	222500	28.6081	80.5997	295				
94356	222500	28.6104	80.6024	6				
94356	222500	28.6104	80.6024	60				
94356	222500	28.6057	80.5970	6				
94356	222500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	222500	28.6267	80.6207	6				
94356	222500	28.6267	80.6207	295				
94356	222500	28.6286	80.6238	6				
94356	222500	28.6286	80.6238	60				
94356	222500	28.6244	80.6184	6				
94356	222500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:30:00 ZULU TIME (T + 11 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	223000	28.4330	80.5712	6			60	
94356	223000	28.4330	80.5712	12	313	2		
94356	223000	28.4330	80.5712	54	328	3	60	
94356	223000	28.4598	80.5267	6			60	
94356	223000	28.4598	80.5267	12	319	3		
94356	223000	28.4598	80.5267	54	307	4	61	
94356	223000	28.4997	80.5487	6				
94356	223000	28.4997	80.5487	12				
94356	223000	28.4997	80.5487	54				
94356	223000	28.4997	80.5487	162				
94356	223000	28.4997	80.5487	204				
94356	223000	28.5361	80.5732	6			60	
94356	223000	28.5361	80.5732	12	293	3		
94356	223000	28.5361	80.5732	54	305	5	59	
94356	223000	28.5698	80.5836	6			61	
94356	223000	28.5698	80.5836	12	284	3		
94356	223000	28.5698	80.5836	54	287	5	61	59
94356	223000	28.5698	80.5836	162	279	5		
94356	223000	28.5698	80.5836	204	289	5	60	
94356	223000	28.6139	80.6136	6			61	
94356	223000	28.6139	80.6136	12	273	3		
94356	223000	28.6139	80.6136	54	273	4	61	
94356	223000	28.4605	80.5697	6			61	
94356	223000	28.4605	80.5697	12	333	2		
94356	223000	28.4605	80.5697	54	320	4	60	
94356	223000	28.6026	80.6320	6			60	
94356	223000	28.6026	80.6320	12	282	2		
94356	223000	28.6026	80.6320	54	0	0	59	
94356	223000	28.6253	80.6459	6			60	56
94356	223000	28.6253	80.6459	12	295	2		
94356	223000	28.6253	80.6459	54	279	3	60	56
94356	223000	28.6253	80.6459	162	284	5		
94356	223000	28.6253	80.6459	204	281	5	60	56
94356	223000	28.6253	80.6459	295	290	6		
94356	223000	28.6253	80.6459	394	281	7		
94356	223000	28.6253	80.6459	492	283	7	58	55
94356	223000	28.4585	80.5904	6			61	
94356	223000	28.4585	80.5904	12	320	2		
94356	223000	28.4585	80.5904	54	309	4	60	
94356	223000	28.6060	80.6606	6			60	
94356	223000	28.6060	80.6606	12	294	1		
94356	223000	28.6060	80.6606	54	281	2	59	
94356	223000	28.6581	80.6836	6			60	
94356	223000	28.6581	80.6836	12	290	1		
94356	223000	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	223000	28.5160	80.6306	6			60	
94356	223000	28.5160	80.6306	12	302	3		
94356	223000	28.5160	80.6306	54	287	3	59	
94356	223000	28.5622	80.6566	6			60	
94356	223000	28.5622	80.6566	12	0	0		
94356	223000	28.5622	80.6566	54			60	
94356	223000	28.6426	80.7261	6			61	
94356	223000	28.6426	80.7261	12	302	1		
94356	223000	28.6426	80.7261	54	296	4	61	
94356	223000	28.4634	80.6570	6				
94356	223000	28.4634	80.6570	12				
94356	223000	28.4634	80.6570	54				
94356	223000	28.7356	80.7321	6				
94356	223000	28.7356	80.7321	60				
94356	223000	28.6860	80.7017	6				
94356	223000	28.6860	80.7017	60				
94356	223000	28.5268	80.7538	6				
94356	223000	28.5268	80.7538	30	295	1		
94356	223000	28.5542	80.6850	6				
94356	223000	28.5542	80.6850	54	294	4		
94356	223000	28.5180	80.6800	6				
94356	223000	28.5180	80.6800	54	290	3		
94356	223000	28.6052	80.7938	6				
94356	223000	28.6052	80.7938	54	276	2		
94356	223000	28.5416	80.7814	6				
94356	223000	28.5416	80.7814	54				
94356	223000	28.6309	80.6860	6				
94356	223000	28.6309	80.6860	30				
94356	223000	28.5983	80.6677	6				
94356	223000	28.5983	80.6677	30				
94356	223000	28.6148	80.6773	6				
94356	223000	28.6148	80.6773	30				
94356	223000	28.6081	80.5997	6				
94356	223000	28.6081	80.5997	295				
94356	223000	28.6081	80.5997	6				
94356	223000	28.6081	80.5997	295				
94356	223000	28.6104	80.6024	6				
94356	223000	28.6104	80.6024	60				
94356	223000	28.6057	80.5970	6				
94356	223000	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	223000	28.6267	80.6207	6				
94356	223000	28.6267	80.6207	295				
94356	223000	28.6286	80.6238	6				
94356	223000	28.6286	80.6238	60				
94356	223000	28.6244	80.6184	6				
94356	223000	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:35:00 ZULU TIME (T + 16 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	223500	28.4330	80.5712	6			60	
94356	223500	28.4330	80.5712	12	315	2		
94356	223500	28.4330	80.5712	54	322	3	60	
94356	223500	28.4598	80.5267	6			60	
94356	223500	28.4598	80.5267	12	313	3		
94356	223500	28.4598	80.5267	54	305	4	61	
94356	223500	28.4997	80.5487	6				
94356	223500	28.4997	80.5487	12				
94356	223500	28.4997	80.5487	54				
94356	223500	28.4997	80.5487	162				
94356	223500	28.4997	80.5487	204				
94356	223500	28.5361	80.5732	6			60	
94356	223500	28.5361	80.5732	12	289	3		
94356	223500	28.5361	80.5732	54	305	5	59	
94356	223500	28.5698	80.5836	6			61	
94356	223500	28.5698	80.5836	12	282	3		
94356	223500	28.5698	80.5836	54	282	5	61	59
94356	223500	28.5698	80.5836	162	275	5		
94356	223500	28.5698	80.5836	204	286	5	59	
94356	223500	28.6139	80.6136	6			61	
94356	223500	28.6139	80.6136	12	263	3		
94356	223500	28.6139	80.6136	54	272	5	61	
94356	223500	28.4605	80.5697	6			61	
94356	223500	28.4605	80.5697	12	317	1		
94356	223500	28.4605	80.5697	54	315	2	60	
94356	223500	28.6026	80.6320	6			60	
94356	223500	28.6026	80.6320	12	280	1		
94356	223500	28.6026	80.6320	54			59	
94356	223500	28.6253	80.6459	6			60	56
94356	223500	28.6253	80.6459	12	291	1		
94356	223500	28.6253	80.6459	54	276	2	60	56
94356	223500	28.6253	80.6459	162	281	4		
94356	223500	28.6253	80.6459	204	278	4	60	56
94356	223500	28.6253	80.6459	295	285	5		
94356	223500	28.6253	80.6459	394	277	6		
94356	223500	28.6253	80.6459	492	277	6	58	55
94356	223500	28.4585	80.5904	6			61	
94356	223500	28.4585	80.5904	12	328	3		
94356	223500	28.4585	80.5904	54	311	4	60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	223500	28.6060	80.6606	6			60	
94356	223500	28.6060	80.6606	12	304	0		
94356	223500	28.6060	80.6606	54	274	1	59	
94356	223500	28.6581	80.6836	6			60	
94356	223500	28.6581	80.6836	12	219	0		
94356	223500	28.6581	80.6836	54			60	
94356	223500	28.5160	80.6306	6			60	
94356	223500	28.5160	80.6306	12	287	3		
94356	223500	28.5160	80.6306	54	279	3	59	
94356	223500	28.5622	80.6566	6			60	
94356	223500	28.5622	80.6566	12	0	0		
94356	223500	28.5622	80.6566	54			60	
94356	223500	28.6426	80.7261	6			61	
94356	223500	28.6426	80.7261	12	304	1		
94356	223500	28.6426	80.7261	54	301	5	61	
94356	223500	28.4634	80.6570	6				
94356	223500	28.4634	80.6570	12				
94356	223500	28.4634	80.6570	54				
94356	223500	28.7356	80.7321	6				
94356	223500	28.7356	80.7321	60				
94356	223500	28.6860	80.7017	6				
94356	223500	28.6860	80.7017	60				
94356	223500	28.5268	80.7538	6				
94356	223500	28.5268	80.7538	30	291	0		
94356	223500	28.5542	80.6850	6				
94356	223500	28.5542	80.6850	54	295	3		
94356	223500	28.5180	80.6800	6				
94356	223500	28.5180	80.6800	54	285	4		
94356	223500	28.6052	80.7938	6				
94356	223500	28.6052	80.7938	54	271	2		
94356	223500	28.5416	80.7814	6				
94356	223500	28.5416	80.7814	54				
94356	223500	28.6309	80.6860	6				
94356	223500	28.6309	80.6860	30				
94356	223500	28.5983	80.6677	6				
94356	223500	28.5983	80.6677	30				
94356	223500	28.6148	80.6773	6				
94356	223500	28.6148	80.6773	30				
94356	223500	28.6081	80.5997	6				
94356	223500	28.6081	80.5997	295				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	223500	28.6104	80.6024	6				
94356	223500	28.6104	80.6024	60				
94356	223500	28.6057	80.5970	6				
94356	223500	28.6057	80.5970	60				
94356	223500	28.6267	80.6207	6				
94356	223500	28.6267	80.6207	295				
94356	223500	28.6286	80.6238	6				
94356	223500	28.6286	80.6238	60				
94356	223500	28.6244	80.6184	6				
94356	223500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:45:00 ZULU TIME (T + 26 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	224500	28.4330	80.5712	6			60	
94356	224500	28.4330	80.5712	12	318	1		
94356	224500	28.4330	80.5712	54	329	3	60	
94356	224500	28.4598	80.5267	6			60	
94356	224500	28.4598	80.5267	12	325	3		
94356	224500	28.4598	80.5267	54	314	3	61	
94356	224500	28.4997	80.5487	6				
94356	224500	28.4997	80.5487	12				
94356	224500	28.4997	80.5487	54				
94356	224500	28.4997	80.5487	162				
94356	224500	28.4997	80.5487	204				
94356	224500	28.5361	80.5732	6			60	
94356	224500	28.5361	80.5732	12	284	2		
94356	224500	28.5361	80.5732	54	295	3	59	
94356	224500	28.5698	80.5836	6			61	
94356	224500	28.5698	80.5836	12	281	2		
94356	224500	28.5698	80.5836	54	285	4	61	59
94356	224500	28.5698	80.5836	162	278	4		
94356	224500	28.5698	80.5836	204	290	4	59	
94356	224500	28.6139	80.6136	6			61	
94356	224500	28.6139	80.6136	12	272	2		
94356	224500	28.6139	80.6136	54	277	3	61	
94356	224500	28.4605	80.5697	6			61	
94356	224500	28.4605	80.5697	12	298	1		
94356	224500	28.4605	80.5697	54	301	2	60	
94356	224500	28.6026	80.6320	6			60	
94356	224500	28.6026	80.6320	12	298	1		
94356	224500	28.6026	80.6320	54	0	0	60	
94356	224500	28.6253	80.6459	6			60	56
94356	224500	28.6253	80.6459	12	281	1		
94356	224500	28.6253	80.6459	54	256	2	60	56
94356	224500	28.6253	80.6459	162	269	2		
94356	224500	28.6253	80.6459	204	268	3	60	56
94356	224500	28.6253	80.6459	295	279	4		
94356	224500	28.6253	80.6459	394	271	5		
94356	224500	28.6253	80.6459	492	272	5	58	55
94356	224500	28.4585	80.5904	6			61	
94356	224500	28.4585	80.5904	12	323	2		
94356	224500	28.4585	80.5904	54	307	3	60	
94356	224500	28.6060	80.6606	6			60	
94356	224500	28.6060	80.6606	12	0	0		
94356	224500	28.6060	80.6606	54	267	1	59	
94356	224500	28.6581	80.6836	6			60	
94356	224500	28.6581	80.6836	12	285	1		
94356	224500	28.6581	80.6836	54			61	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	224500	28.5160	80.6306	6			60	
94356	224500	28.5160	80.6306	12	259	3		
94356	224500	28.5160	80.6306	54	261	2	59	
94356	224500	28.5622	80.6566	6			60	
94356	224500	28.5622	80.6566	12	0	0		
94356	224500	28.5622	80.6566	54			60	
94356	224500	28.6426	80.7261	6			61	
94356	224500	28.6426	80.7261	12	305	1		
94356	224500	28.6426	80.7261	54	302	5	60	
94356	224500	28.4634	80.6570	6				
94356	224500	28.4634	80.6570	12				
94356	224500	28.4634	80.6570	54				
94356	224500	28.7356	80.7321	6				
94356	224500	28.7356	80.7321	60				
94356	224500	28.6860	80.7017	6				
94356	224500	28.6860	80.7017	60				
94356	224500	28.5268	80.7538	6				
94356	224500	28.5268	80.7538	30	273	1		
94356	224500	28.5542	80.6850	6				
94356	224500	28.5542	80.6850	54	280	4		
94356	224500	28.5180	80.6800	6				
94356	224500	28.5180	80.6800	54	293	3		
94356	224500	28.6052	80.7938	6				
94356	224500	28.6052	80.7938	54	294	2		
94356	224500	28.5416	80.7814	6				
94356	224500	28.5416	80.7814	54				
94356	224500	28.6309	80.6860	6				
94356	224500	28.6309	80.6860	30				
94356	224500	28.5983	80.6677	6				
94356	224500	28.5983	80.6677	30				
94356	224500	28.6148	80.6773	6				
94356	224500	28.6148	80.6773	30				
94356	224500	28.6081	80.5997	6				
94356	224500	28.6081	80.5997	295				
94356	224500	28.6081	80.5997	6				
94356	224500	28.6081	80.5997	295				
94356	224500	28.6104	80.6024	6				
94356	224500	28.6104	80.6024	60				
94356	224500	28.6057	80.5970	6				
94356	224500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	224500	28.6267	80.6207	6				
94356	224500	28.6267	80.6207	295				
94356	224500	28.6286	80.6238	6				
94356	224500	28.6286	80.6238	60				
94356	224500	28.6244	80.6184	6				
94356	224500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 22:55:00 ZULU TIME (T + 36 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	225500	28.4330	80.5712	6			60	
94356	225500	28.4330	80.5712	12	329	1		
94356	225500	28.4330	80.5712	54	335	2	60	
94356	225500	28.4598	80.5267	6			60	
94356	225500	28.4598	80.5267	12	332	2		
94356	225500	28.4598	80.5267	54	317	2	61	
94356	225500	28.4997	80.5487	6				
94356	225500	28.4997	80.5487	12				
94356	225500	28.4997	80.5487	54				
94356	225500	28.4997	80.5487	162				
94356	225500	28.4997	80.5487	204				
94356	225500	28.5361	80.5732	6			60	
94356	225500	28.5361	80.5732	12	286	2		
94356	225500	28.5361	80.5732	54	297	3	59	
94356	225500	28.5698	80.5836	6			61	
94356	225500	28.5698	80.5836	12	292	2		
94356	225500	28.5698	80.5836	54	290	3	61	59
94356	225500	28.5698	80.5836	162	283	3		
94356	225500	28.5698	80.5836	204	293	4	59	
94356	225500	28.6139	80.6136	6			61	
94356	225500	28.6139	80.6136	12	265	3		
94356	225500	28.6139	80.6136	54	276	4	61	
94356	225500	28.4605	80.5697	6			60	
94356	225500	28.4605	80.5697	12	318	1		
94356	225500	28.4605	80.5697	54	307	2	60	
94356	225500	28.6026	80.6320	6			60	
94356	225500	28.6026	80.6320	12	293	1		
94356	225500	28.6026	80.6320	54			60	
94356	225500	28.6253	80.6459	6			60	56
94356	225500	28.6253	80.6459	12	295	1		
94356	225500	28.6253	80.6459	54	276	2	60	56
94356	225500	28.6253	80.6459	162	279	4		
94356	225500	28.6253	80.6459	204	279	4	60	56
94356	225500	28.6253	80.6459	295	288	5		
94356	225500	28.6253	80.6459	394	281	6		
94356	225500	28.6253	80.6459	492	279	6	58	55
94356	225500	28.4585	80.5904	6			61	
94356	225500	28.4585	80.5904	12	310	2		
94356	225500	28.4585	80.5904	54	291	3	60	
94356	225500	28.6060	80.6606	6			60	
94356	225500	28.6060	80.6606	12	297	0		
94356	225500	28.6060	80.6606	54	269	1	59	
94356	225500	28.6581	80.6836	6			60	
94356	225500	28.6581	80.6836	12	305	0		
94356	225500	28.6581	80.6836	54			61	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	225500	28.5160	80.6306	6			60	
94356	225500	28.5160	80.6306	12	286	3		
94356	225500	28.5160	80.6306	54	269	2	59	
94356	225500	28.5622	80.6566	6			60	
94356	225500	28.5622	80.6566	12	234	0		
94356	225500	28.5622	80.6566	54			60	
94356	225500	28.6426	80.7261	6			61	
94356	225500	28.6426	80.7261	12	322	1		
94356	225500	28.6426	80.7261	54	309	4	60	
94356	225500	28.4634	80.6570	6				
94356	225500	28.4634	80.6570	12				
94356	225500	28.4634	80.6570	54				
94356	225500	28.7356	80.7321	6				
94356	225500	28.7356	80.7321	60				
94356	225500	28.6860	80.7017	6				
94356	225500	28.6860	80.7017	60				
94356	225500	28.5268	80.7538	6				
94356	225500	28.5268	80.7538	30	304	0		
94356	225500	28.5542	80.6850	6				
94356	225500	28.5542	80.6850	54	305	2		
94356	225500	28.5180	80.6800	6				
94356	225500	28.5180	80.6800	54	295	2		
94356	225500	28.6052	80.7938	6				
94356	225500	28.6052	80.7938	54	279	2		
94356	225500	28.5416	80.7814	6				
94356	225500	28.5416	80.7814	54				
94356	225500	28.6309	80.6860	6				
94356	225500	28.6309	80.6860	30				
94356	225500	28.5983	80.6677	6				
94356	225500	28.5983	80.6677	30				
94356	225500	28.6148	80.6773	6				
94356	225500	28.6148	80.6773	30				
94356	225500	28.6081	80.5997	6				
94356	225500	28.6081	80.5997	295				
94356	225500	28.6081	80.5997	6				
94356	225500	28.6081	80.5997	295				
94356	225500	28.6104	80.6024	6				
94356	225500	28.6104	80.6024	60				
94356	225500	28.6057	80.5970	6				
94356	225500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	225500	28.6267	80.6207	6				
94356	225500	28.6267	80.6207	295				
94356	225500	28.6286	80.6238	6				
94356	225500	28.6286	80.6238	60				
94356	225500	28.6244	80.6184	6				
94356	225500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 23:05:00 ZULU TIME (T + 46 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	230500	28.4330	80.5712	6			60	
94356	230500	28.4330	80.5712	12	291	1		
94356	230500	28.4330	80.5712	54	316	3	60	
94356	230500	28.4598	80.5267	6			60	
94356	230500	28.4598	80.5267	12	330	1		
94356	230500	28.4598	80.5267	54	317	2	61	
94356	230500	28.4997	80.5487	6				
94356	230500	28.4997	80.5487	12				
94356	230500	28.4997	80.5487	54				
94356	230500	28.4997	80.5487	162				
94356	230500	28.4997	80.5487	204				
94356	230500	28.5361	80.5732	6			60	
94356	230500	28.5361	80.5732	12	295	2		
94356	230500	28.5361	80.5732	54	305	3	59	
94356	230500	28.5698	80.5836	6			61	
94356	230500	28.5698	80.5836	12	303	2		
94356	230500	28.5698	80.5836	54	304	4	61	59
94356	230500	28.5698	80.5836	162	297	4		
94356	230500	28.5698	80.5836	204	305	5	60	
94356	230500	28.6139	80.6136	6			61	
94356	230500	28.6139	80.6136	12	261	2		
94356	230500	28.6139	80.6136	54	275	4	60	
94356	230500	28.4605	80.5697	6			60	
94356	230500	28.4605	80.5697	12	271	1		
94356	230500	28.4605	80.5697	54	271	2	60	
94356	230500	28.6026	80.6320	6			60	
94356	230500	28.6026	80.6320	12	288	1		
94356	230500	28.6026	80.6320	54			60	
94356	230500	28.6253	80.6459	6			60	56
94356	230500	28.6253	80.6459	12	289	1		
94356	230500	28.6253	80.6459	54	279	3	60	56
94356	230500	28.6253	80.6459	162	288	5		
94356	230500	28.6253	80.6459	204	287	5	60	56
94356	230500	28.6253	80.6459	295	295	6		
94356	230500	28.6253	80.6459	394	288	6		
94356	230500	28.6253	80.6459	492	285	6	58	55
94356	230500	28.4585	80.5904	6			61	
94356	230500	28.4585	80.5904	12	296	2		
94356	230500	28.4585	80.5904	54	284	4	60	
94356	230500	28.6060	80.6606	6			60	
94356	230500	28.6060	80.6606	12	279	0		
94356	230500	28.6060	80.6606	54	266	1	59	
94356	230500	28.6581	80.6836	6			60	
94356	230500	28.6581	80.6836	12	285	1		
94356	230500	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	230500	28.5160	80.6306	6			60	
94356	230500	28.5160	80.6306	12	268	3		
94356	230500	28.5160	80.6306	54	264	2	59	
94356	230500	28.5622	80.6566	6			60	
94356	230500	28.5622	80.6566	12	0	0		
94356	230500	28.5622	80.6566	54			60	
94356	230500	28.6426	80.7261	6			61	
94356	230500	28.6426	80.7261	12	289	1		
94356	230500	28.6426	80.7261	54	297	5	60	
94356	230500	28.4634	80.6570	6				
94356	230500	28.4634	80.6570	12				
94356	230500	28.4634	80.6570	54				
94356	230500	28.7356	80.7321	6				
94356	230500	28.7356	80.7321	60				
94356	230500	28.6860	80.7017	6				
94356	230500	28.6860	80.7017	60				
94356	230500	28.5268	80.7538	6				
94356	230500	28.5268	80.7538	30	307	0		
94356	230500	28.5542	80.6850	6				
94356	230500	28.5542	80.6850	54	295	4		
94356	230500	28.5180	80.6800	6				
94356	230500	28.5180	80.6800	54	307	3		
94356	230500	28.6052	80.7938	6				
94356	230500	28.6052	80.7938	54	284	0		
94356	230500	28.5416	80.7814	6				
94356	230500	28.5416	80.7814	54				
94356	230500	28.6309	80.6860	6				
94356	230500	28.6309	80.6860	30				
94356	230500	28.5983	80.6677	6				
94356	230500	28.5983	80.6677	30				
94356	230500	28.6148	80.6773	6				
94356	230500	28.6148	80.6773	30				
94356	230500	28.6081	80.5997	6				
94356	230500	28.6081	80.5997	295				
94356	230500	28.6081	80.5997	6				
94356	230500	28.6081	80.5997	295				
94356	230500	28.6104	80.6024	6				
94356	230500	28.6104	80.6024	60				
94356	230500	28.6057	80.5970	6				
94356	230500	28.6057	80.5970	60				

94356	230500	28.6267	80.6207	6
94356	230500	28.6267	80.6207	295
94356	230500	28.6267	80.6207	6
94356	230500	28.6267	80.6207	295
94356	230500	28.6286	80.6238	6
94356	230500	28.6286	80.6238	60
94356	230500	28.6244	80.6184	6
94356	230500	28.6244	80.6184	60

METEOROLOGICAL TOWER DATA AT 23:15:00 ZULU TIME (T + 56 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	231500	28.4330	80.5712	6			60	
94356	231500	28.4330	80.5712	12	311	2		
94356	231500	28.4330	80.5712	54	323	3	60	
94356	231500	28.4598	80.5267	6			60	
94356	231500	28.4598	80.5267	12	332	1		
94356	231500	28.4598	80.5267	54	321	2	60	
94356	231500	28.4997	80.5487	6				
94356	231500	28.4997	80.5487	12				
94356	231500	28.4997	80.5487	54				
94356	231500	28.4997	80.5487	162				
94356	231500	28.4997	80.5487	204				
94356	231500	28.5361	80.5732	6			60	
94356	231500	28.5361	80.5732	12	310	2		
94356	231500	28.5361	80.5732	54	317	3	59	
94356	231500	28.5698	80.5836	6			61	
94356	231500	28.5698	80.5836	12	305	2		
94356	231500	28.5698	80.5836	54	309	3	61	59
94356	231500	28.5698	80.5836	162	297	4		
94356	231500	28.5698	80.5836	204	303	5	60	
94356	231500	28.6139	80.6136	6			61	
94356	231500	28.6139	80.6136	12	297	1		
94356	231500	28.6139	80.6136	54	293	2	61	
94356	231500	28.4605	80.5697	6			60	
94356	231500	28.4605	80.5697	12	265	1		
94356	231500	28.4605	80.5697	54	271	2	60	
94356	231500	28.6026	80.6320	6			60	
94356	231500	28.6026	80.6320	12	302	1		
94356	231500	28.6026	80.6320	54			59	
94356	231500	28.6253	80.6459	6			60	57
94356	231500	28.6253	80.6459	12	317	1		
94356	231500	28.6253	80.6459	54	292	2	60	56
94356	231500	28.6253	80.6459	162	301	4		
94356	231500	28.6253	80.6459	204	301	4	60	56
94356	231500	28.6253	80.6459	295	312	5		
94356	231500	28.6253	80.6459	394	300	5		
94356	231500	28.6253	80.6459	492	300	6	58	55
94356	231500	28.4585	80.5904	6			61	
94356	231500	28.4585	80.5904	12	305	1		
94356	231500	28.4585	80.5904	54	289	4	60	
94356	231500	28.6060	80.6606	6			60	
94356	231500	28.6060	80.6606	12	271	1		
94356	231500	28.6060	80.6606	54	260	1	59	
94356	231500	28.6581	80.6836	6			60	
94356	231500	28.6581	80.6836	12	274	0		
94356	231500	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	231500	28.5160	80.6306	6			60	
94356	231500	28.5160	80.6306	12	301	3		
94356	231500	28.5160	80.6306	54	284	2	59	
94356	231500	28.5622	80.6566	6			60	
94356	231500	28.5622	80.6566	12	0	0		
94356	231500	28.5622	80.6566	54			60	
94356	231500	28.6426	80.7261	6			61	
94356	231500	28.6426	80.7261	12	306	1		
94356	231500	28.6426	80.7261	54	303	4	60	
94356	231500	28.4634	80.6570	6				
94356	231500	28.4634	80.6570	12				
94356	231500	28.4634	80.6570	54				
94356	231500	28.7356	80.7321	6				
94356	231500	28.7356	80.7321	60				
94356	231500	28.6860	80.7017	6				
94356	231500	28.6860	80.7017	60				
94356	231500	28.5268	80.7538	6				
94356	231500	28.5268	80.7538	30	345	0		
94356	231500	28.5542	80.6850	6				
94356	231500	28.5542	80.6850	54	310	5		
94356	231500	28.5180	80.6800	6				
94356	231500	28.5180	80.6800	54	303	2		
94356	231500	28.6052	80.7938	6				
94356	231500	28.6052	80.7938	54	0	0		
94356	231500	28.5416	80.7814	6				
94356	231500	28.5416	80.7814	54				
94356	231500	28.6309	80.6860	6				
94356	231500	28.6309	80.6860	30				
94356	231500	28.5983	80.6677	6				
94356	231500	28.5983	80.6677	30				
94356	231500	28.6148	80.6773	6				
94356	231500	28.6148	80.6773	30				
94356	231500	28.6081	80.5997	6				
94356	231500	28.6081	80.5997	295				
94356	231500	28.6081	80.5997	6				
94356	231500	28.6081	80.5997	295				
94356	231500	28.6104	80.6024	6				
94356	231500	28.6104	80.6024	60				
94356	231500	28.6057	80.5970	6				
94356	231500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	231500	28.6267	80.6207	6				
94356	231500	28.6267	80.6207	295				
94356	231500	28.6286	80.6238	6				
94356	231500	28.6286	80.6238	60				
94356	231500	28.6244	80.6184	6				
94356	231500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 23:35:00 ZULU TIME (T + 1 hour and 16 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	233500	28.4330	80.5712	6			60	
94356	233500	28.4330	80.5712	12	304	1		
94356	233500	28.4330	80.5712	54	313	3	60	
94356	233500	28.4598	80.5267	6			60	
94356	233500	28.4598	80.5267	12	304	1		
94356	233500	28.4598	80.5267	54	306	2	60	
94356	233500	28.4997	80.5487	6				
94356	233500	28.4997	80.5487	12				
94356	233500	28.4997	80.5487	54				
94356	233500	28.4997	80.5487	162				
94356	233500	28.4997	80.5487	204				
94356	233500	28.5361	80.5732	6			61	
94356	233500	28.5361	80.5732	12	293	2		
94356	233500	28.5361	80.5732	54	312	3	59	
94356	233500	28.5698	80.5836	6			61	
94356	233500	28.5698	80.5836	12	294	2		
94356	233500	28.5698	80.5836	54	293	3	61	59
94356	233500	28.5698	80.5836	162	292	4		
94356	233500	28.5698	80.5836	204	301	5	60	
94356	233500	28.6139	80.6136	6			61	
94356	233500	28.6139	80.6136	12	285	1		
94356	233500	28.6139	80.6136	54	287	3	61	
94356	233500	28.4605	80.5697	6			60	
94356	233500	28.4605	80.5697	12	289	1		
94356	233500	28.4605	80.5697	54	307	2	59	
94356	233500	28.6026	80.6320	6			60	
94356	233500	28.6026	80.6320	12	274	1		
94356	233500	28.6026	80.6320	54			60	
94356	233500	28.6253	80.6459	6			60	57
94356	233500	28.6253	80.6459	12	297	2		
94356	233500	28.6253	80.6459	54	283	3	60	56
94356	233500	28.6253	80.6459	162	296	5		
94356	233500	28.6253	80.6459	204	296	5	60	56
94356	233500	28.6253	80.6459	295	307	6		
94356	233500	28.6253	80.6459	394	298	7		
94356	233500	28.6253	80.6459	492	297	7	58	55
94356	233500	28.4585	80.5904	6			61	
94356	233500	28.4585	80.5904	12	327	3		
94356	233500	28.4585	80.5904	54	307	4	60	
94356	233500	28.6060	80.6606	6			60	
94356	233500	28.6060	80.6606	12	277	1		
94356	233500	28.6060	80.6606	54	277	1	59	
94356	233500	28.6581	80.6836	6			60	
94356	233500	28.6581	80.6836	12	328	0		
94356	233500	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	233500	28.5160	80.6306	6			60	
94356	233500	28.5160	80.6306	12	304	3		
94356	233500	28.5160	80.6306	54	289	2	59	
94356	233500	28.5622	80.6566	6			60	
94356	233500	28.5622	80.6566	12	0	0		
94356	233500	28.5622	80.6566	54			60	
94356	233500	28.6426	80.7261	6			61	
94356	233500	28.6426	80.7261	12	309	1		
94356	233500	28.6426	80.7261	54	305	4	60	
94356	233500	28.4634	80.6570	6				
94356	233500	28.4634	80.6570	12				
94356	233500	28.4634	80.6570	54				
94356	233500	28.7356	80.7321	6				
94356	233500	28.7356	80.7321	60				
94356	233500	28.6860	80.7017	6				
94356	233500	28.6860	80.7017	60				
94356	233500	28.5268	80.7538	6				
94356	233500	28.5268	80.7538	30	317	0		
94356	233500	28.5542	80.6850	6				
94356	233500	28.5542	80.6850	54	301	5		
94356	233500	28.5180	80.6800	6				
94356	233500	28.5180	80.6800	54	289	3		
94356	233500	28.6052	80.7938	6				
94356	233500	28.6052	80.7938	54	327	1		
94356	233500	28.5416	80.7814	6				
94356	233500	28.5416	80.7814	54				
94356	233500	28.6309	80.6860	6				
94356	233500	28.6309	80.6860	30				
94356	233500	28.5983	80.6677	6				
94356	233500	28.5983	80.6677	30				
94356	233500	28.6148	80.6773	6				
94356	233500	28.6148	80.6773	30				
94356	233500	28.6081	80.5997	6				
94356	233500	28.6081	80.5997	295				
94356	233500	28.6081	80.5997	6				
94356	233500	28.6081	80.5997	295				
94356	233500	28.6104	80.6024	6				
94356	233500	28.6104	80.6024	60				
94356	233500	28.6057	80.5970	6				
94356	233500	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94356	233500	28.6267	80.6207	6				
94356	233500	28.6267	80.6207	295				
94356	233500	28.6286	80.6238	6				
94356	233500	28.6286	80.6238	60				
94356	233500	28.6244	80.6184	6				
94356	233500	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 00:00:00 ZULU TIME (T + 1 hour and 41 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94357	0	28.4330	80.5712	6			60	
94357	0	28.4330	80.5712	12	319	1		
94357	0	28.4330	80.5712	54	330	3	60	
94357	0	28.4598	80.5267	6			60	
94357	0	28.4598	80.5267	12	301	1		
94357	0	28.4598	80.5267	54	300	2	61	
94357	0	28.4997	80.5487	6				
94357	0	28.4997	80.5487	12				
94357	0	28.4997	80.5487	54				
94357	0	28.4997	80.5487	162				
94357	0	28.4997	80.5487	204				
94357	0	28.5361	80.5732	6			60	
94357	0	28.5361	80.5732	12	292	1		
94357	0	28.5361	80.5732	54	301	2	59	
94357	0	28.5698	80.5836	6			61	
94357	0	28.5698	80.5836	12	321	1		
94357	0	28.5698	80.5836	54	319	2	61	59
94357	0	28.5698	80.5836	162	316	2		
94357	0	28.5698	80.5836	204	328	2	60	
94357	0	28.6139	80.6136	6			61	
94357	0	28.6139	80.6136	12	326	2		
94357	0	28.6139	80.6136	54	318	2	60	
94357	0	28.4605	80.5697	6			60	
94357	0	28.4605	80.5697	12	293	0		
94357	0	28.4605	80.5697	54	317	0	59	
94357	0	28.6026	80.6320	6			60	
94357	0	28.6026	80.6320	12	318	1		
94357	0	28.6026	80.6320	54			59	
94357	0	28.6253	80.6459	6			60	57
94357	0	28.6253	80.6459	12	353	1		
94357	0	28.6253	80.6459	54	339	2	60	56
94357	0	28.6253	80.6459	162	336	2		
94357	0	28.6253	80.6459	204	331	3	60	56
94357	0	28.6253	80.6459	295	335	3		
94357	0	28.6253	80.6459	394	327	4		
94357	0	28.6253	80.6459	492	328	4	58	55
94357	0	28.4585	80.5904	6			61	
94357	0	28.4585	80.5904	12	346	2		
94357	0	28.4585	80.5904	54	333	3	60	
94357	0	28.6060	80.6606	6				
94357	0	28.6060	80.6606	12	289	0		
94357	0	28.6060	80.6606	54	338	1	59	
94357	0	28.6581	80.6836	6			60	
94357	0	28.6581	80.6836	12	356	1		
94357	0	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94357	0	28.5160	80.6306	6			60	
94357	0	28.5160	80.6306	12	306	2		
94357	0	28.5160	80.6306	54	298	1	59	
94357	0	28.5622	80.6566	6			60	
94357	0	28.5622	80.6566	12	0	0		
94357	0	28.5622	80.6566	54				
94357	0	28.6426	80.7261	6				
94357	0	28.6426	80.7261	12	327	1		
94357	0	28.6426	80.7261	54	331	4	60	
94357	0	28.4634	80.6570	6				
94357	0	28.4634	80.6570	12				
94357	0	28.4634	80.6570	54				
94357	0	28.7356	80.7321	6				
94357	0	28.7356	80.7321	60				
94357	0	28.6860	80.7017	6				
94357	0	28.6860	80.7017	60				
94357	0	28.5268	80.7538	6				
94357	0	28.5268	80.7538	30	0	0		
94357	0	28.5542	80.6850	6				
94357	0	28.5542	80.6850	54	11	2		
94357	0	28.5180	80.6800	6				
94357	0	28.5180	80.6800	54	298	1		
94357	0	28.6052	80.7938	6				
94357	0	28.6052	80.7938	54	310	0		
94357	0	28.5416	80.7814	6				
94357	0	28.5416	80.7814	54				
94357	0	28.6309	80.6860	6				
94357	0	28.6309	80.6860	30				
94357	0	28.5983	80.6677	6				
94357	0	28.5983	80.6677	30				
94357	0	28.6148	80.6773	6				
94357	0	28.6148	80.6773	30				
94357	0	28.6081	80.5997	6				
94357	0	28.6081	80.5997	295				
94357	0	28.6081	80.5997	6				
94357	0	28.6081	80.5997	295				
94357	0	28.6104	80.6024	6				
94357	0	28.6104	80.6024	60				
94357	0	28.6057	80.5970	6				
94357	0	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94357	0	28.6267	80.6207	6				
94357	0	28.6267	80.6207	295				
94357	0	28.6286	80.6238	6				
94357	0	28.6286	80.6238	60				
94357	0	28.6244	80.6184	6				
94357	0	28.6244	80.6184	60				

METEOROLOGICAL TOWER DATA AT 00:30:00 ZULU TIME (T + 2 hours and 11 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94357	3000	28.4330	80.5712	6			60	
94357	3000	28.4330	80.5712	12	299	1		
94357	3000	28.4330	80.5712	54	9	1	60	
94357	3000	28.4598	80.5267	6			60	
94357	3000	28.4598	80.5267	12	242	1		
94357	3000	28.4598	80.5267	54	246	2	60	
94357	3000	28.4997	80.5487	6				
94357	3000	28.4997	80.5487	12				
94357	3000	28.4997	80.5487	54				
94357	3000	28.4997	80.5487	162				
94357	3000	28.4997	80.5487	204				
94357	3000	28.5361	80.5732	6			60	
94357	3000	28.5361	80.5732	12	249	1		
94357	3000	28.5361	80.5732	54	237	1	59	
94357	3000	28.5698	80.5836	6			61	
94357	3000	28.5698	80.5836	12	279	1		
94357	3000	28.5698	80.5836	54	280	2	61	59
94357	3000	28.5698	80.5836	162	264	2		
94357	3000	28.5698	80.5836	204	277	2	60	
94357	3000	28.6139	80.6136	6			61	
94357	3000	28.6139	80.6136	12	294	2		
94357	3000	28.6139	80.6136	54	303	3	60	
94357	3000	28.4605	80.5697	6			60	
94357	3000	28.4605	80.5697	12	254	1		
94357	3000	28.4605	80.5697	54	274	0	59	
94357	3000	28.6026	80.6320	6			59	
94357	3000	28.6026	80.6320	12	251	1		
94357	3000	28.6026	80.6320	54			59	
94357	3000	28.6253	80.6459	6			60	56
94357	3000	28.6253	80.6459	12	294	1		
94357	3000	28.6253	80.6459	54	301	2	60	56
94357	3000	28.6253	80.6459	162	338	2		
94357	3000	28.6253	80.6459	204	338	2	60	56
94357	3000	28.6253	80.6459	295	354	3		
94357	3000	28.6253	80.6459	394	343	4		
94357	3000	28.6253	80.6459	492	341	4	58	55
94357	3000	28.4585	80.5904	6			61	
94357	3000	28.4585	80.5904	12	301	1		
94357	3000	28.4585	80.5904	54	278	3	60	
94357	3000	28.6060	80.6606	6				
94357	3000	28.6060	80.6606	12	289	1		
94357	3000	28.6060	80.6606	54	0	0	59	
94357	3000	28.6581	80.6836	6			60	
94357	3000	28.6581	80.6836	12	297	1		
94357	3000	28.6581	80.6836	54			60	

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94357	3000	28.5160	80.6306	6				
94357	3000	28.5160	80.6306	12	252	3		
94357	3000	28.5160	80.6306	54	233	2	59	
94357	3000	28.5622	80.6566	6			60	
94357	3000	28.5622	80.6566	12	0	0		
94357	3000	28.5622	80.6566	54				
94357	3000	28.6426	80.7261	6				
94357	3000	28.6426	80.7261	12	276	1		
94357	3000	28.6426	80.7261	54	291	3	60	
94357	3000	28.4634	80.6570	6				
94357	3000	28.4634	80.6570	12				
94357	3000	28.4634	80.6570	54				
94357	3000	28.7356	80.7321	6				
94357	3000	28.7356	80.7321	60				
94357	3000	28.6860	80.7017	6				
94357	3000	28.6860	80.7017	60				
94357	3000	28.5268	80.7538	6				
94357	3000	28.5268	80.7538	30	254	1		
94357	3000	28.5542	80.6850	6				
94357	3000	28.5542	80.6850	54	0	0		
94357	3000	28.5180	80.6800	6				
94357	3000	28.5180	80.6800	54	235	2		
94357	3000	28.6052	80.7938	6				
94357	3000	28.6052	80.7938	54	249	0		
94357	3000	28.5416	80.7814	6				
94357	3000	28.5416	80.7814	54				
94357	3000	28.6309	80.6860	6				
94357	3000	28.6309	80.6860	30				
94357	3000	28.5983	80.6677	6				
94357	3000	28.5983	80.6677	30				
94357	3000	28.6148	80.6773	6				
94357	3000	28.6148	80.6773	30				
94357	3000	28.6081	80.5997	6				
94357	3000	28.6081	80.5997	295				
94357	3000	28.6081	80.5997	6				
94357	3000	28.6081	80.5997	295				
94357	3000	28.6104	80.6024	6				
94357	3000	28.6104	80.6024	60				
94357	3000	28.6057	80.5970	6				
94357	3000	28.6057	80.5970	60				

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
94357	3000	28.6267	80.6207	6				
94357	3000	28.6267	80.6207	295				
94357	3000	28.6286	80.6238	6				
94357	3000	28.6286	80.6238	60				
94357	3000	28.6244	80.6184	6				
94357	3000	28.6244	80.6184	60				

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE
CAPE CANAVERAL AFS, FLORIDA
19:49 Zulu Time, 22 DEC 94 (T - 2 hours and 30 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	310	10.0	.000	16.4	14.9	1008.70	91	12.69	1205.91	346	665	16.96	0
1000	311	13.0	.005	13.9	13.4	973.74	97	11.65	1174.80	333	662	15.43	4
2000	309	14.3	.002	13.1	12.2	939.25	94	10.76	1136.46	319	661	14.21	7
3000	302	12.8	.004	11.0	9.4	905.84	90	9.03	1105.13	302	659	11.85	10
4000	294	10.6	.005	9.2	7.3	873.34	88	7.83	1072.81	288	656	10.20	12
5000	280	10.7	.004	8.1	7.5	841.88	96	8.00	1038.04	281	655	10.39	15
6000	265	13.2	.007	6.7	5.7	811.41	93	7.08	1005.72	269	654	9.14	17
7000	256	16.2	.006	7.6	1.4	782.03	65	5.22	967.31	248	654	6.76	19
8000	258	17.0	.001	4.8	-.4	753.58	69	4.62	941.82	239	651	5.93	20
9000	254	17.5	.002	4.3	-12.1	725.99	29	1.89	910.59	215	650	2.42	21
10000	255	18.2	.002	2.3	-13.8	699.27	29	1.65	883.31	207	647	2.10	22
11000	257	21.4	.005	-.4	-14.6	673.31	33	1.56	859.20	201	644	1.97	22
12000	256	27.5	.010	-2.1	-24.9	648.09	15	.64	832.67	190	642	.80	23
13000	256	33.2	.010	-3.3	-25.9	623.71	15	.59	804.99	183	640	.74	23
14000	257	36.4	.006	-4.4	-26.7	600.13	16	.55	777.72	177	639	.68	23
15000	259	39.4	.006	-5.6	-27.6	577.35	16	.51	751.59	171	638	.63	23
16000	258	44.0	.008	-7.5	-29.2	555.33	16	.44	728.11	165	635	.54	23
17000	256	48.1	.008	-9.2	-30.6	534.01	16	.39	704.70	160	633	.47	23
18000	256	49.3	.002	-11.6	-32.2	513.33	16	.34	683.66	155	630	.41	23
19000	257	49.6	.001	-14.0	-33.8	493.29	17	.29	662.92	150	628	.35	24
20000	256	49.6	.001	-16.1	-35.5	473.86	17	.25	642.00	145	625	.29	24
21000	256	50.8	.002	-18.6	-37.4	455.04	17	.21	622.73	140	622	.24	24
22000	258	53.2	.005	-20.6	-39.1	436.80	17	.17	602.33	135	620	.20	24
23000	261	55.9	.006	-22.5	-40.7	419.16	17	.15	582.62	131	617	.17	24
24000	262	57.4	.003	-24.5	-42.4	402.11	17	.12	563.26	126	615	.14	24
25000	261	57.4	.001	-26.9	-44.1	385.62	18	.10	545.53	122	612	.12	24
26000	261	57.2	.001	-29.4	-46.0	369.65	18	.09	528.33	118	609	.10	24
27000	262	57.6	.002	-32.0	-48.0	354.18	18	.07	511.58	114	605	.08	24
28000	264	58.0	.003	-34.9	-50.3	339.20	19	.05	495.93	111	602	.06	24
29000	265	57.0	.003	-37.2	-52.5	324.69	18	.04	479.40	107	599	.05	24
30000	266	54.4	.005	-39.9	-55.2	310.66	18	.03	464.04	104	595	.03	24
31000	266	52.8	.003	-41.6	-56.5	297.11	18	.03	447.09	100	593	.03	24
32000	265	53.4	.002	-43.4	-57.9	284.06	18	.02	430.79	96	591	.02	24
33000	264	54.5	.002	-45.5	-59.6	271.48	18	.02	415.42	93	588	.02	24
34000	261	54.4	.005	-47.7	-61.4	259.35	18	.01	400.72	89	585	.01	24
35000	256	54.3	.007	-49.4	-62.9	247.66	19	.01	385.65	86	583	.01	24
36000	253	56.3	.006	-50.6	-63.8	236.43	19	.01	370.02	83	582	.01	24
37000	254	59.6	.006	-51.6	-64.7	225.65	19	.01	354.90	79	580	.01	24
38000	255	62.8	.006	-52.1	-65.1	215.34	19	.01	339.32	76	580	.01	24
39000	255	65.3	.005	-51.4	-64.5	205.49	19	.01	322.77	72	581	.01	24
40000	257	68.0	.006	-51.6	-64.8	196.13	19	.01	308.43	69	580	.01	24
41000	262	72.8	.012	-51.3	-64.6	187.18	18	.01	293.94	66	581	.01	24
42000	265	74.3	.007	-51.2	-64.5	178.66	18	.01	280.47	63	581	.01	24
43000	266	71.1	.006	-52.3	-65.4	170.50	18	.01	268.96	60	579	.01	24
44000	264	65.6	.010	-53.3	-66.2	162.67	19	.01	257.77	57	578	.01	24
45000	263	61.1	.008	-54.7	-67.4	155.17	19	.01	247.48	55	576	.01	24
46000	259	56.3	.011	-56.7	-69.0	147.96	19	.01	238.17	53	573	.01	24
47000	254	52.6	.010	-57.1	-69.4	141.04	19	.00	227.47	51	573	.00	24
48000	256	50.4	.004	-57.8	-69.9	134.44	19	.00	217.47	48	572	.00	24

TERMINATION 52256 GEOPFT 15928 GEOPM 108.1 MBS

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE
CAPE CANAVERAL AFS, FLORIDA
20:59 Zulu Time, 22 DEC 94 (T - 1 hour and 20 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	310	10.0	.000	16.3	14.5	1008.40	89	12.38	1206.16	344	665	16.54	0
1000	303	13.0	.006	13.9	13.4	973.45	97	11.65	1174.22	333	662	15.43	4
2000	305	14.7	.003	13.6	12.5	938.99	93	10.96	1134.19	320	662	14.50	7
3000	299	13.4	.004	12.4	11.5	905.71	94	10.32	1098.67	308	661	13.60	10
4000	288	11.8	.005	11.1	9.9	873.46	92	9.30	1064.95	295	659	12.19	13
5000	275	12.9	.005	9.3	8.7	842.17	96	8.64	1033.67	284	657	11.26	16
6000	264	17.1	.009	8.5	5.9	811.86	84	7.16	1000.02	268	656	9.31	18
7000	262	19.5	.004	7.9	-3.4	782.57	46	3.80	967.85	239	654	4.94	20
8000	261	20.8	.002	6.0	-6.7	754.15	40	2.87	939.43	227	652	3.70	21
9000	260	22.0	.002	4.0	-9.8	726.57	36	2.27	911.83	218	649	2.91	22
10000	262	23.4	.003	1.4	-13.7	699.76	32	1.68	887.01	208	646	2.13	22
11000	262	26.6	.006	-1.0	-24.6	673.70	15	.66	861.87	196	643	.83	23
12000	255	30.8	.009	-2.6	-26.4	648.42	14	.56	834.67	190	641	.70	23
13000	252	33.6	.005	-3.2	-26.8	624.00	14	.55	804.94	183	641	.68	23
14000	252	33.6	.000	-4.4	-28.0	600.43	14	.49	777.93	176	639	.61	23
15000	253	34.2	.001	-6.4	-29.5	577.62	14	.43	754.15	171	637	.53	23
16000	253	38.7	.008	-8.6	-30.9	555.50	14	.38	731.31	165	634	.46	24
17000	251	46.0	.013	-9.4	-31.9	534.10	14	.34	705.23	159	633	.42	24
18000	250	50.3	.007	-11.9	-33.2	513.42	15	.30	684.43	155	630	.37	24
19000	250	51.8	.003	-14.2	-34.7	493.35	16	.27	663.48	150	627	.32	24
20000	251	54.1	.004	-16.2	-36.5	473.92	15	.22	642.33	145	625	.27	24
21000	254	57.3	.007	-18.0	-38.0	455.11	15	.19	621.37	140	623	.23	24
22000	256	59.9	.006	-19.7	-39.4	436.92	15	.17	600.41	135	621	.20	24
23000	257	60.0	.002	-22.1	-41.3	419.34	15	.14	581.73	131	618	.16	24
24000	258	58.8	.003	-24.4	-43.3	402.29	15	.11	563.39	126	615	.13	24
25000	260	58.1	.003	-27.1	-45.2	385.79	16	.09	546.09	122	612	.11	24
26000	260	58.6	.002	-29.5	-47.1	369.80	16	.08	528.71	118	608	.08	24
27000	261	59.2	.001	-31.9	-49.0	354.32	16	.06	511.66	114	605	.07	24
28000	261	58.7	.001	-34.5	-50.9	339.35	17	.05	495.26	111	602	.05	24
29000	261	56.4	.004	-37.6	-53.9	324.84	16	.04	480.32	107	598	.04	24
30000	261	53.5	.005	-39.7	-55.9	310.79	16	.03	463.71	104	596	.03	24
31000	261	52.2	.002	-41.4	-57.3	297.25	16	.02	446.75	100	593	.03	24
32000	262	52.7	.001	-43.3	-58.9	284.22	16	.02	430.72	96	591	.02	24
33000	261	53.6	.002	-45.5	-60.7	271.63	16	.02	415.69	93	588	.02	24
34000	259	53.2	.003	-47.8	-62.6	259.49	16	.01	401.09	89	585	.01	24
35000	255	53.3	.007	-49.8	-64.2	247.78	16	.01	386.50	86	583	.01	24
36000	250	55.1	.007	-50.7	-64.9	236.53	16	.01	370.42	83	581	.01	24

TERMINATION 37367 GEOPFT 11390 GEOPM 220.7 MBS

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE
CAPE CANAVERAL AFS, FLORIDA
22:04 Zulu Time, 22 DEC 94 (T - 15 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	310	4.0	.000	15.6	14.3	1008.10	92	12.24	1208.83	344	664	16.31	0
1000	304	10.9	.012	13.8	13.4	973.17	97	11.59	1174.61	333	662	15.34	4
2000	308	14.3	.006	12.7	11.9	938.67	95	10.59	1137.55	319	661	13.97	7
3000	304	14.0	.002	11.1	10.5	905.26	96	9.68	1103.65	306	659	12.70	10
4000	287	11.8	.008	10.2	9.1	872.88	93	8.87	1067.92	293	658	11.60	13
5000	278	12.2	.003	8.6	7.6	841.55	93	8.03	1035.55	281	656	10.45	15
6000	260	16.3	.010	8.3	7.5	811.22	95	7.98	999.21	273	656	10.37	18
7000	264	21.0	.008	7.4	-5.5	781.89	39	3.12	968.92	235	654	4.05	19
8000	260	23.0	.004	5.5	-7.5	753.44	38	2.70	940.25	227	651	3.48	20
9000	256	25.7	.005	3.3	-11.1	725.82	34	2.05	913.48	217	649	2.62	21
10000	254	28.7	.005	.9	-12.0	698.97	37	1.92	887.23	210	646	2.43	22
11000	251	31.3	.005	-1.0	-22.6	672.92	17	.79	860.92	197	643	.99	22
12000	248	33.7	.005	-2.4	-25.6	647.68	15	.61	833.14	190	641	.76	22
13000	247	33.8	.001	-3.3	-26.8	623.29	14	.55	804.27	183	640	.68	22
14000	247	32.7	.002	-4.5	-27.5	599.73	15	.51	777.38	177	639	.64	22
15000	245	33.1	.002	-6.7	-29.4	576.93	14	.43	754.16	171	636	.53	23
16000	246	38.4	.009	-9.4	-30.7	554.79	16	.38	732.60	166	633	.47	23
17000	248	46.0	.013	-10.8	-30.4	533.32	18	.41	707.97	160	631	.49	23
18000	248	52.0	.010	-12.4	-33.7	512.60	15	.29	684.77	154	629	.35	23
19000	247	53.7	.003	-14.7	-35.0	492.53	16	.26	663.62	150	627	.31	23
20000	248	55.5	.003	-16.5	-36.8	473.09	15	.22	642.14	145	624	.26	23
21000	251	58.6	.007	-18.4	-38.4	454.29	15	.19	621.06	140	622	.22	23
22000	253	61.6	.007	-20.7	-40.3	436.08	15	.15	601.72	135	619	.18	23
23000	253	62.5	.001	-22.4	-41.7	418.48	15	.13	581.24	130	617	.15	23

TERMINATION 24869 GEOPFT 7580 GEOPM 386.0 MBS

TECHNOLOGY OPERATIONS

The Aerospace Corporation functions as an "architect-engineer" for national security programs, specializing in advanced military space systems. The Corporation's Technology Operations supports the effective and timely development and operation of national security systems through scientific research and the application of advanced technology. Vital to the success of the Corporation is the technical staff's wide-ranging expertise and its ability to stay abreast of new technological developments and program support issues associated with rapidly evolving space systems. Contributing capabilities are provided by these individual Technology Centers:

Electronics Technology Center: Microelectronics, VLSI reliability, failure analysis, solid-state device physics, compound semiconductors, radiation effects, infrared and CCD detector devices, Micro-Electro-Mechanical Systems (MEMS), and data storage and display technologies; lasers and electro-optics, solid state laser design, micro-optics, optical communications, and fiber optic sensors; atomic frequency standards, applied laser spectroscopy, laser chemistry, atmospheric propagation and beam control, LIDAR/LADAR remote sensing; solar cell and array testing and evaluation, battery electrochemistry, battery testing and evaluation.

Mechanics and Materials Technology Center: Evaluation and characterization of new materials: metals, alloys, ceramics, polymers and their composites, and new forms of carbon; development and analysis of thin films and deposition techniques; nondestructive evaluation, component failure analysis and reliability; fracture mechanics and stress corrosion; development and evaluation of hardened components; analysis and evaluation of materials at cryogenic and elevated temperatures; launch vehicle and reentry fluid mechanics, heat transfer and flight dynamics; chemical and electric propulsion; spacecraft structural mechanics, spacecraft survivability and vulnerability assessment; contamination, thermal and structural control; high temperature thermomechanics, gas kinetics and radiation; lubrication and surface phenomena.

Space and Environment Technology Center: Magnetospheric, auroral and cosmic ray physics, wave-particle interactions, magnetospheric plasma waves; atmospheric and ionospheric physics, density and composition of the upper atmosphere, remote sensing using atmospheric radiation; solar physics, infrared astronomy, infrared signature analysis; effects of solar activity, magnetic storms and nuclear explosions on the earth's atmosphere, ionosphere and magnetosphere; effects of electromagnetic and particulate radiations on space systems; space instrumentation; propellant chemistry, chemical dynamics, environmental chemistry, trace detection; atmospheric chemical reactions, atmospheric optics, light scattering, state-specific chemical reactions and radiative signatures of missile plumes, and sensor out-of-field-of-view rejection.